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FINAL
Sediment Monitoring Summary Report 2007 Remedial Dredging

Environmental Monitoring, Sampling, and Analysis

New Bedford Harbor Superfund Site

New Bedford Harbor, MA

FINAL REPORT

Sediment Monitoring Summary Report
2007 Remedial Dredging

Environmental Monitoring, Sampling, and Analysis
New Bedford Harbor Superfund Site
New Bedford Harbor, MA

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

EXECUTIVE SUMMARY

Sediment sampling was performed at New Bedford Harbor from June to November 2007 in support of remedial dredging activities. In 2007, dredge activities occurred primarily in two areas, including 'Area G' which encompasses southern sections of DMU-1 and DMU-102 and 'Area H' which encompasses sections of DMU-9 and DMU-10, and DMU-11. Dredging activities targeted removal of sediments to the approximate depth of the target dredge elevation (where polychlorinated biphenyl (PCB) concentrations are predicted, based on modeling, to be less than the 10 mg/kg remediation criteria). Sediment cores were collected before, during, and after dredging to evaluate the target dredge elevation estimates through visual characterization and observation of the elevation of sediment-type transitions. Sediment monitoring was also performed in 2007 at the OU3 Pilot Cap and proposed Boat House areas to characterize PCBs in sediment.

Site-wide geostatistical modeling based on historical PCB data has been used to develop an estimation of the vertical elevation of PCB contamination in the sediments (target dredge elevation). The dredge plan for each year is based on the target dredge elevations and contours within the planned footprint of dredging. However, changes in sediment condition over time or uncertainties in the model can result in a discrepancy between the target dredge elevation estimates and the existing features at the site. Elevation data based on the visual characterization of cores collected prior to dredging at Areas G and H in June 2007 were used to refine the dredge plan in terms of target dredge depths and sediment thickness. As a result target dredge depths were reduced, thereby reducing dredging and disposal efforts.

The collection of post-dredge cores revealed that the depth of the sediment surface and the overall thickness of OL (organic silt, organic clay according to the Unified Soil Classification System) layers were reduced across all dredged areas. However, the post-dredge cores collected within the same dredge areas (but generally at different locations) generally had less distinct visual transitions compared to the pre-dredge cores. The transitions generally occurred over a relatively broad band (>0.5-ft) of mixed sediment and in many cases, the elevation of the post-dredge visual transition also occurred at a deeper elevation than observed during the pre-dredge coring investigation.

Total PCB concentrations in post-dredge surface sediment sampled at Area G ranged from 74 mg/kg to 660 mg/kg, with no clear distribution trend except that total PCB concentrations appeared to be lower in surface sediment sampled along the eastern boundary of the dredge area. Post-dredge total PCB concentrations ranged from 5.4 mg/kg to 1,400 mg/kg at Area H. The highest PCB concentrations were measured in the fined-grained, organic-rich sediments sampled along the western boundary. Lower PCB concentrations were measured in sandy, low TOC sediments sampled near the eastern boundary.

There were no substantive changes in total PCB concentrations since 2005 in surficial sediments sampled at the OU3 Pilot Cap site, suggesting that the cap placement is still effective in this area.

Total PCB concentrations in sediment sampled at the proposed Boat House area were highest at the surface and generally decreased with depth. Most of the sediments sampled 2-ft below the surface had total PCB concentrations well below 1 mg/kg.

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1.0 INTRODUCTION

1.1 Site Description

The New Bedford Harbor Superfund Site (Site), located in Bristol County, Massachusetts (MA), extends from the shallow northern reaches of the Acushnet River estuary south through the commercial harbor of New Bedford and into 17,000 adjacent acres of Buzzards Bay (Figure 1). Industrial and urban development surrounding the harbor has resulted in sediments becoming contaminated with high concentrations of many pollutants, notably polychlorinated biphenyls (PCBs) and heavy metals. Two manufacturers in the area used PCBs while producing electronic devices from the 1940s to the late 1970s, when the use of PCBs was banned by the U.S. Environmental Protection Agency (USEPA). Based on human health concerns and ecological risk assessments, USEPA added New Bedford Harbor to the National Priorities List in 1983 as a designated Superfund Site. Through an Interagency Agreement between the USEPA and the U.S. Army Corps of Engineers, New England District (USACE NAE), the USACE is responsible for carrying out the design and implementation of the remedial measures at the Site. The Site has been divided into three areas – the upper, lower and outer harbors – consistent with geographical features of the area and gradients of contamination (Figure 2).

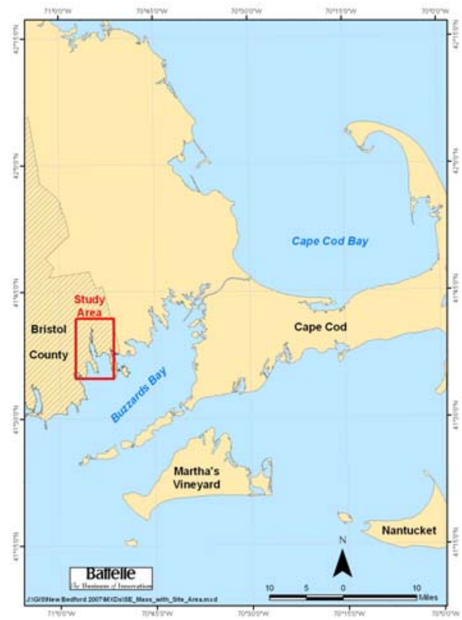

Figure 1. Location of the Site in Southeastern, MA.

Aerovox Inc. located in New Bedford, MA used PCBs in the manufacture of electrical capacitors from approximately 1940 to 1977. This facility is located in the upper harbor and is considered one of the major sources of historic PCB contamination to New Bedford Harbor. The highest concentrations of PCBs were found in sediments in a 5-acre area in the northern portion of the Acushnet River Estuary adjacent to the Aerovox facility. These ‘hot spot’ sediments, which contained PCBs upwards of 100,000 milligrams per kilogram (mg/kg), were removed between 1994 and 1995 as part of USEPA’s 1990 “Hot Spot” Record of Decision (ROD). Full scale remediation dredging per the 1998 Upper and Lower Harbor ROD was initiated in 2004 and continued in 2005, 2006, and 2007. Another known source of PCB contamination in New Bedford Harbor is related to activities at the Cornell-Dubilier mill on the western shore of the outer harbor. In 2005, a 15 acre underwater cap pilot project was implemented near Cornell-Dubilier to cap PCB-contaminated sediments (Figure 2).

Figure 2. Location of the 2007 Dredge Activity Area within New Bedford Harbor

The Site is divided into a series of Dredge Management Units (DMU) based on contamination levels, contamination sources, topography, and other factors. In 2007, dredge activities were conducted at two areas: 'Area G' encompassing sections of DMU-1 and DMU-102 and 'Area H' encompassing sections of DMU-9 and DMU-10, and DMU-11 (Figure 3).

The remediation of the Site involves the excavation and dredging of approximately 880,000 cubic yards of PCB contaminated sediment. The majority of contaminated material is being removed utilizing a hydraulic dredge that pumps dredge slurry to the project's Sawyer Street facility where it is mechanically processed to remove all sand, gravel, and debris material. The silt and clay size materials are then pumped to the Area D Dewatering Facility located on Herman Melville Boulevard where it is mechanically dewatered and transported off-site for disposal.

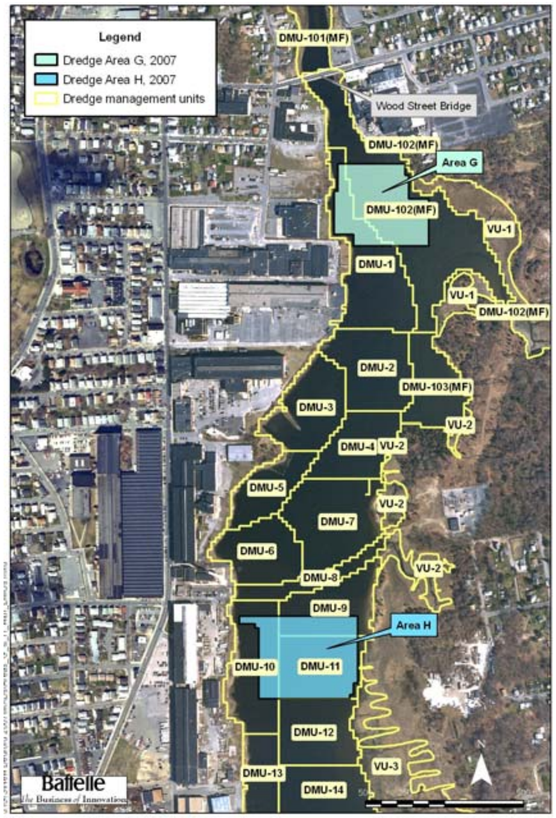

Figure 3. 2007 Dredge Areas.

1.2 Project Objectives

The primary objectives of the 2007 sediment monitoring program were to 1) conduct pre-dredge coring to determine the elevation of the visual transition and sediment thickness of the OL layer ('OL' in the Unified Soil Classification System (USCS), defined as organic silt or organic clay) to assist dredge planning, 2) conduct progress-dredge coring to provide field reconnaissance information during the dredge season to maximize overall dredging productivity, and 3) conduct post-dredge coring to assess the overall performance of the dredging operation and support future needs. Additional objectives included conduct of harbor-wide monitoring at locations determined by the USEPA and USACE NAE. This included sediment monitoring at the OU3 Pilot Cap site near the Cornell-Dubilier Mill and the proposed Boat House area.

1.2.1 Pre-dredge Sediment Sampling

The entire upper harbor, including the planned 2007 dredge areas depicted in Figure 3, have been parceled into discrete 25-foot by 25-foot 'z-blocks'. During remedial design, a geostatistical model was used to predict a target elevation for dredging each z-block. This target dredge elevation, as shown in Figures 4 (Area G) and 5 (Area H), represents the elevation where PCB concentrations are predicted to be less than the 10 mg/kg remediation criteria. Using target dredge elevations in combination with bathymetric data, a preliminary dredge plan was developed which estimated the required depth of dredging and the thickness of the overlying sediment to be removed. The pre-dredge sediment sampling plan was designed to confirm these estimates or adjust elevations as needed. Coring locations were placed onto the z-block map to achieve sufficient spatial coverage for making an evaluation of the target dredge elevations. In areas where the target dredge elevations changed substantially within adjacent z-blocks the concentration of sampling locations was increased. Visual characterization data from the pre-dredge cores was used by NAE and Jacobs Engineering Group (Jacobs) to prepare the final 2007 dredge plan.

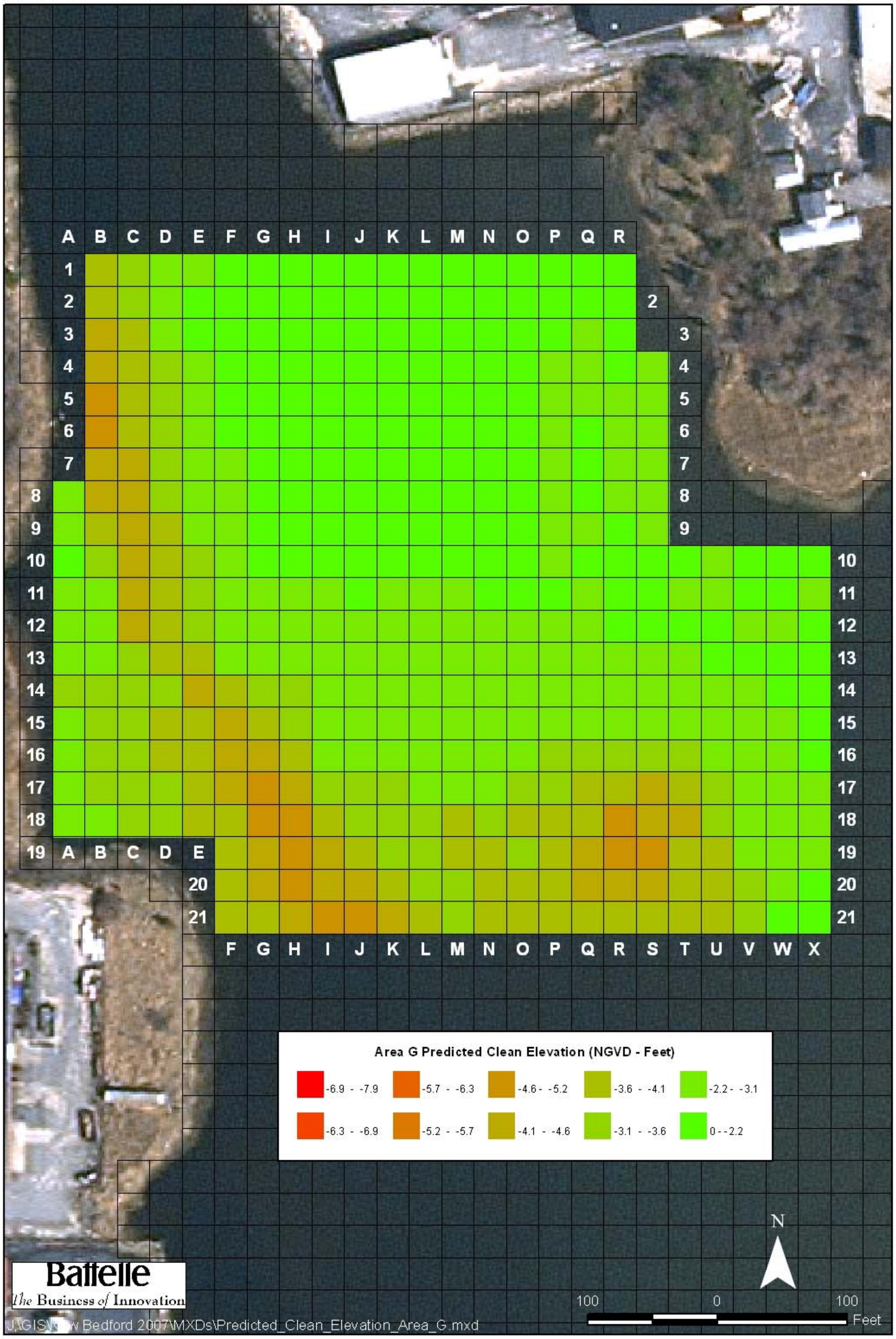

Figure 4. 2007 Planned Dredge Area G with Z-blocks and Target Dredge Elevations.

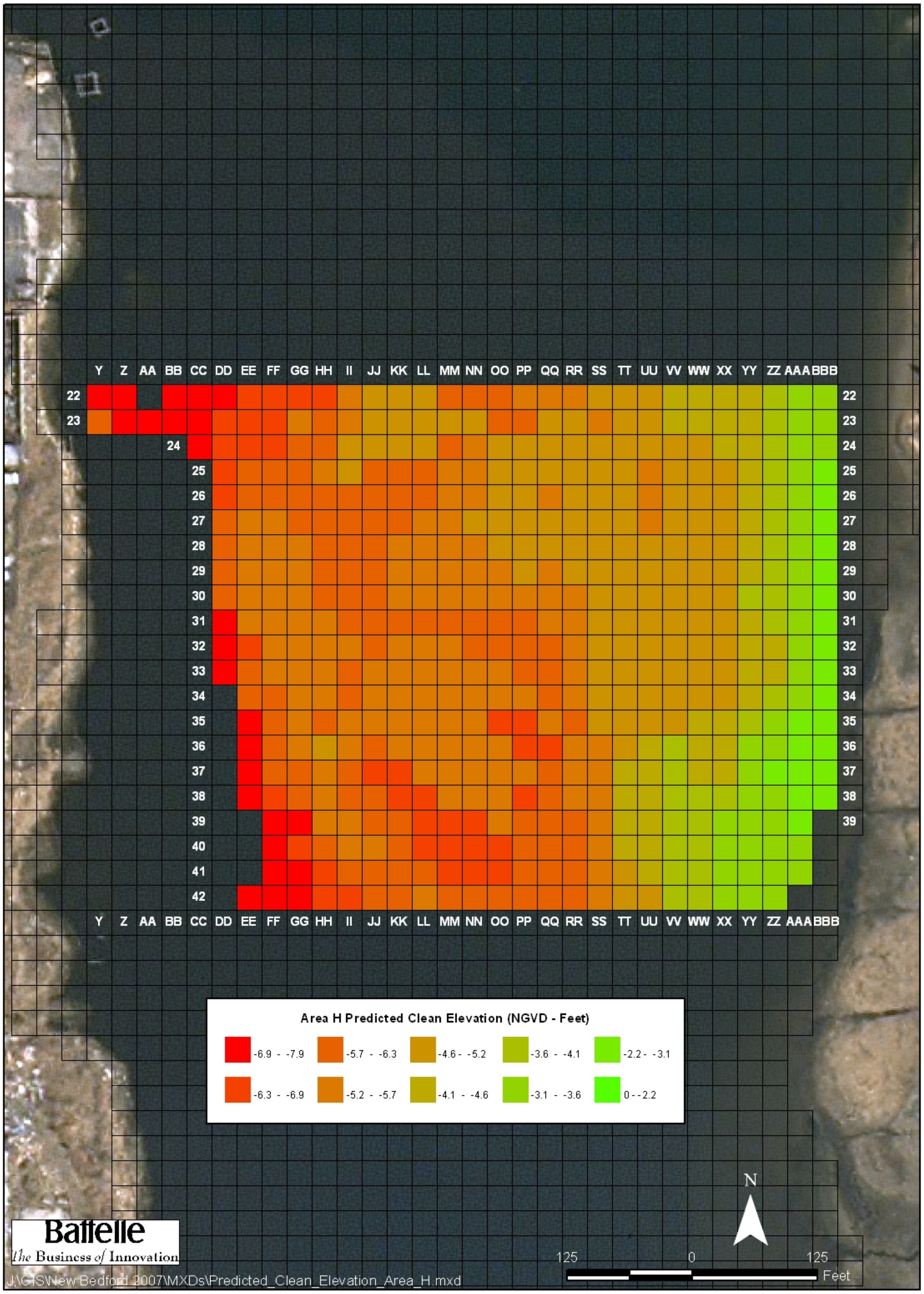

Figure 5. 2007 Planned Dredge Area H with Z-blocks and Target Dredge Elevations.

1.2.2 Progress-dredge Sediment Sampling

Push cores were collected during dredge activities to evaluate the progress of dredging operations and dredge effectiveness. Dredging operations were conducted based on opportunity (tides, weather, equipment, etc) and sample locations were determined through weekly discussions between NAE, Battelle, and Jacobs, based on the dredge operations. Samples collected during this activity received visual characterization only (Section 2.2).

1.2.3 Post-dredge Sediment Sampling

Post-dredge sediment sampling was conducted to assess the sediment condition relative to the target dredge elevation for the entire 2007 dredging event and to assist with future site needs. Visual characterization of these samples was used to determine the elevation and thickness of overlying material remaining after the completion of dredging. Chemical analysis was also performed to assess PCB concentrations remaining in the sediments in these areas. Supplemental analyses, including grain size composition, total organic carbon (TOC), and volatile organic compound (VOC), were performed on selected samples at the direction of USACE NAE.

1.2.4 Harbor-wide Sampling

Additional harbor-wide monitoring was conducted at the direction of USEPA and USACE NAE. In 2007, sediment monitoring was performed to characterize PCBs in sediments at the OU3 Pilot Cap and the proposed Boat House areas.

The OU3 Pilot Cap site is a localized area of elevated PCB concentrations located outside the hurricane barrier in New Bedford, MA (Figure 2). In 2005 the OU3 Pilot Cap site was capped with parent material dredged during the construction of a navigational dredged material Confined Aquatic Disposal (CAD) cell in New Bedford Harbor. Annual monitoring has been conducted since 2005 to assess temporal trends in PCBs in surficial sediments and the effectiveness of the cap.

Sampling was conducted in the area of the proposed Boat House location, located in the upper Harbor, and was completed during post-dredge activities. Sediment cores were collected at 10 locations to characterize PCBs in sediment at three depth intervals: 0-1 ft, 1-2 ft, and 2-3 ft.

1.3 Report Organization

This report describes the activities conducted in 2007 during sampling in New Bedford Harbor in support of dredging operations as part of the remediation of the Site. A description of the Site and project objectives is presented in Section 1. A description of the 2007 sampling and analysis methods is provided in Section 2. Results of the 2007 sediment monitoring, including sediment characteristics and chemistry, are provided in Section 3.0. A discussion of the sediment results is provided in Section 4.0. References are provided in Section 5.0.

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2.0 METHODS

Environmental sampling and analysis methods utilized for the 2007 sediment monitoring program are summarized below and described in detail in the project work plans (Battelle, 2006a, b; Battelle, 2007).

2.1 Sediment Collections

2.1.1 Pre-, Progress-, and Post-dredging Sampling

Pre-, progress-, and post-dredge core samples were collected in 2007 at Areas G (Figure 6) and H (Figure 7). Sampling of sediments was conducted with a push-core sampling device utilizing 3-inch diameter Lexan™ core barrels. The sampling device was designed to securely hold one end of a pre-cut length of core barrel. Core lengths were targeted so that penetration exceeded the expected depth of the target dredge elevation by at least one foot. A piston assembly inside the core barrel was used to create suction during retrieval of the sample to prevent sediment loss from the bottom of the barrel.

Once the individual components of the push core sampler were assembled, sample collection was achieved as follows. The core assembly was measured from the bottom of the core to the top of the assembly. The piston assembly was positioned just inside the leading end of the core liner and the piston line was held loosely on deck. The device was lowered into the water until the leading end of the core bore barrel contacted the sediment surface. The piston attachment line was then tied off securely on the deck of the survey vessel, thus fixing the elevation of piston assembly. In driving the push-core into the sediment, the piston created a syringe effect as the core liner was driven past the fixed elevation of the piston. The core liner was then driven to the maximum depth of either refusal or the limiting depth allowed by the length of the piston attachment line. When retrieving the core assembly (with sample) tension was held on the piston line so that the piston and sample were not pulled back down the core liner by suction from the sediments. The sampler was recovered onto the deck of the survey vessel. The bottom end of the core barrel was fitted with a plastic cap, after which the sediment on the external body of the sampler was rinsed off. After thoroughly cleaning the sampling device the core liner was removed from the socket assembly, the piston assembly was then removed, and the top of the core liner was fitted with a plastic end cap.

Upon recovery, the core was examined for acceptability. The goal of the dredge area sampling was to identify visual transitions. If it did not appear that a clear transition layer was captured, the field team used professional judgment to determine the cause. Possible causes included; 1) the core was not long/deep enough to capture transition layers, 2) smearing of overlying sediments obscured the transition, and 3) the entire core was composed of the characteristic native material. In the first two cases the collection of a second core (longer for case 1) at the same location was conducted. In the third case the field team repositioned slightly and collected a second core. Other factors which were considered in determining acceptability included: 1) too much water at the top of the core, 2) signs of significant compaction at the top of the core, and 3) signs of loss of sediment from the bottom of the core. Because of the wide range of possible scenarios, overall core acceptability was based on the experience and judgment of the Chief Scientist and the field team. All decision making was documented on the Sediment Sampling Log sheets (Appendix A).

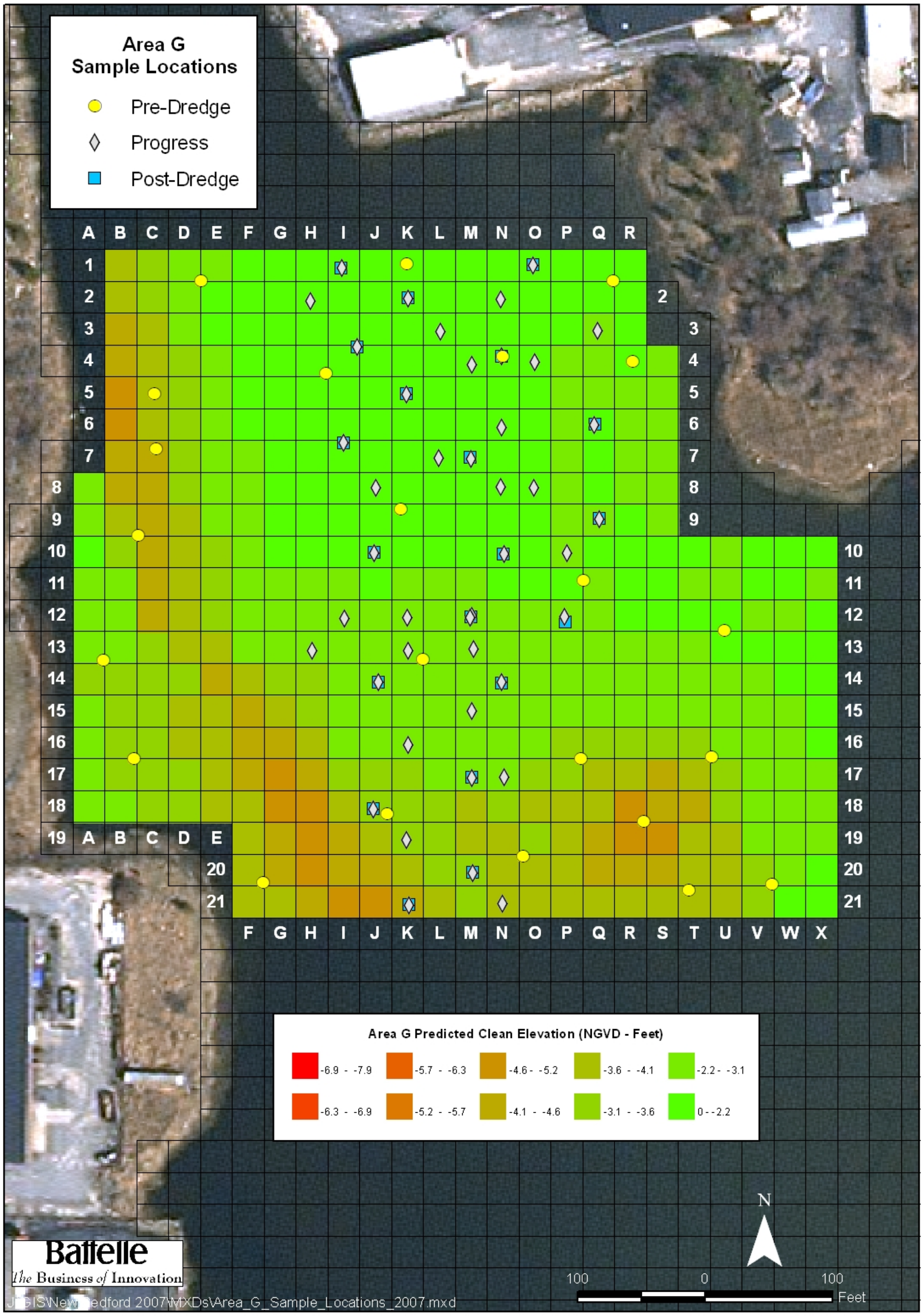

Figure 6. Pre-, Progress-, and Post-dredge Sample Locations at Area G.

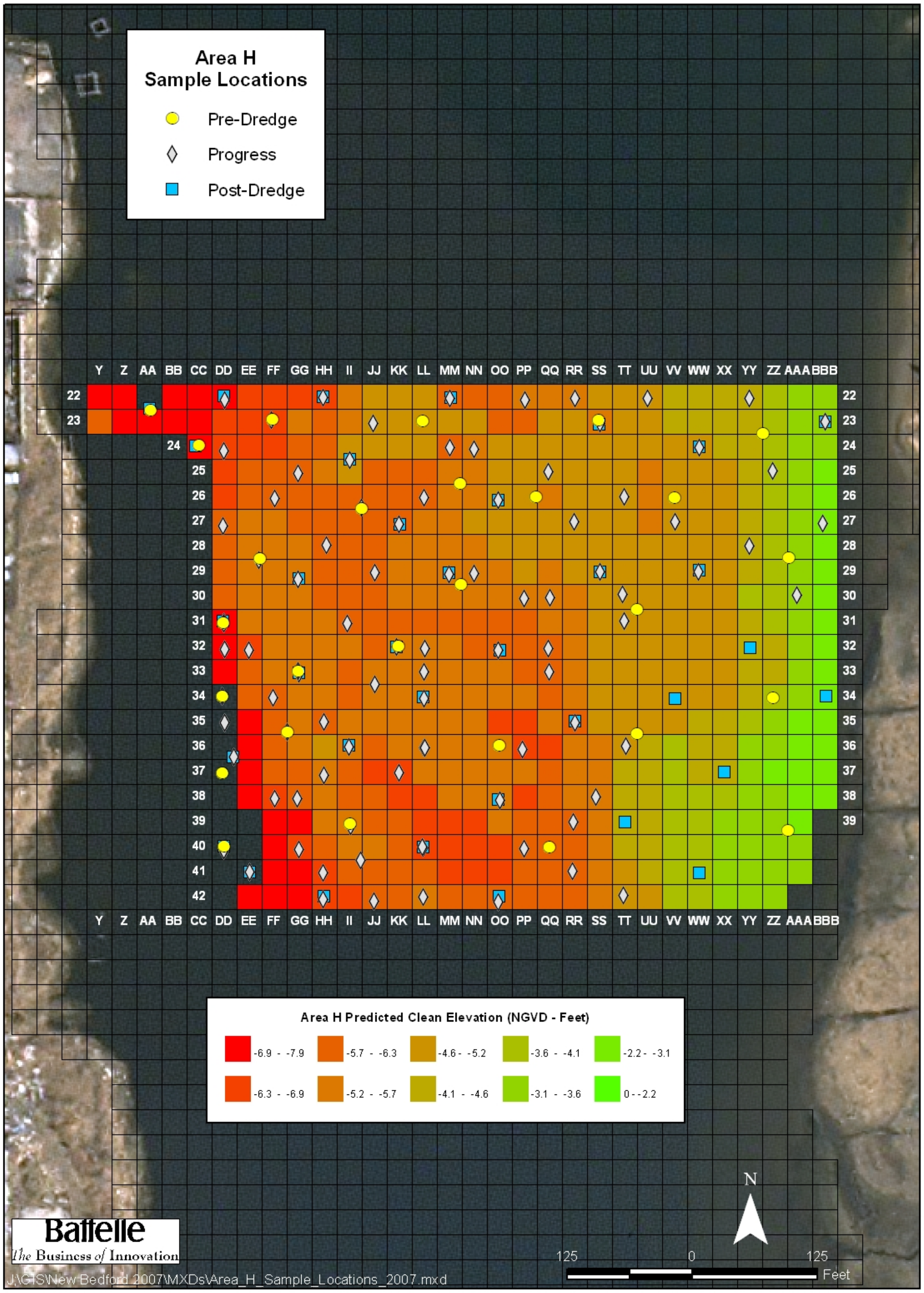

Figure 7. Pre-, Progress-, and Post-dredge Sample Locations at Area H.

Determination of the accurate vertical elevation of the samples was critical in achieving the objectives of the project. Elevation of the water levels, sediment-water interface, apparent target dredge elevation, and other sediment transition zones were all critical measurements for this project (see Section 3 and Appendix A). The project elevation datum is MLW NGVD-29. A series of measurements were conducted for each sample to correct elevations for tidal fluctuations. All measurements were recorded as ±0.1 feet. The required measurements and techniques are listed below. See Figure 8 for graphical depiction of the measurements.

A = **Water depth**. The water depth was recorded using either a lead line or a measuring pole.
B = **Length of push core assembly**. Prior to deployment, the full length of the push core assembly from the top of the handle to the bottom edge of the core liner was recorded.
C = **Water surface to top of core assembly handle**. Once the core assembly was fully inserted (refusal or full core penetration), the length of the assembly remaining above the water surface was recorded.
D = **Core Length**. The core length, from bottom to top, was measured and recorded.
E = **Surveyed elevation**. Prior to operations the dredge contractor installed a fixed sheet pile with markings indicating a survey elevation (NGVD 29). This elevation was recorded and served as the reference point for all elevation calculations.
F = **Water surface from surveyed elevation**. After sample collection, the survey vessel navigated to the fixed sheet pile with surveyed elevations (position to be determined) and the distance from the water surface to the surveyed elevation was recorded.

From theses measurements a number of calculations were made to determine true elevations:

E - F = **Elevation of water surface** (G).
G - (B - C) = **Elevation of bottom of core** (*H*).
The *H* elevation (bottom of core) was used to determine the elevation of all visual transitions, including apparent target dredge elevation. i.e.:

H + (distance to visual transition) = **Elevation of visual transition** (target dredge elevation)
H + D = **Elevation of sediment water interface** (I).

The elevation of the sediment water interface was also calculated from:
G - A = **Elevation of sediment water interface** (I_2).

I and I_2 were compared at each station. In soft sediments the sediment water interface may have been difficult to discern from soundings (i.e. it is difficult to feel). Additionally, the sediment water interface within a core was subject to compaction during collection, settling after recovery, and other factors which may have impacted the accuracy of elevation measurements. If *I* and I_2 varied by more than 1.0 foot, the core was discarded and a new sample collected.

Once the core was deemed acceptable, a Sediment Sampling Log sheet was completed. Sample collection data, including collection date and time, station coordinates, and sample ID, were documented on Sediment Sampling Log forms. The field measurements required for determining vertical elevation of the sediment-water interface and each transitional layer was also included on the Sediment Sampling Log sheet. The core barrel was labeled with a sample ID, date, and the orientation for the top of the core. Chain of Custody for each core section was initiated in the field.

Core samples were capped tightly, stored on ice in the field, and transferred to the Sawyer Street facility for processing (Section 2.2).

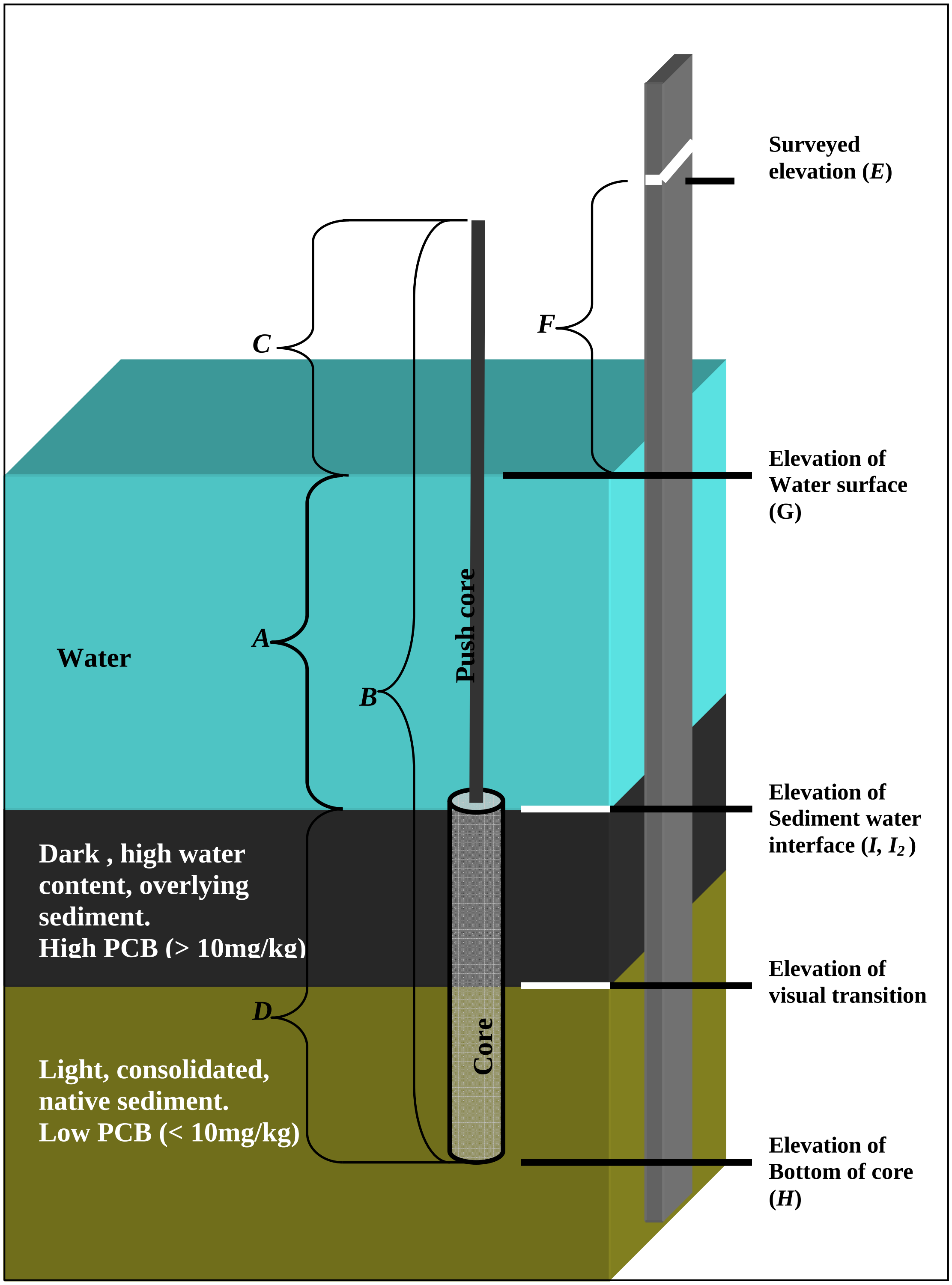

Figure 8. Graphical Depiction of Sediment Core Measurements.

2.1.2 Harbor-wide Sampling

At the direction of USEPA and USACE, sediment sampling was performed at the OU3 Pilot Cap site and the proposed Boat House area.

OU3 Pilot Cap — Grab sampling was conducted at 17 sample locations at the OU3 Pilot Cap site (Figure 2) to collect surficial sediments for PCB analysis. A 0.04m^2 modified Van Veen grab was used to collect sediment samples. Sample locations were based on stations previously visited by ENSR/AECom on August 25, 2005, shortly after the completion of capping activities (ENSR, 2006). Bathymetric data collected just after the capping event revealed a series of ridges and valleys formed by placement of cap materials along an east-west axis. At the time of the 2005 bathymetry and sampling as much as a 4-foot difference in elevation existed amongst the topography at this site. The 2005 sediment sampling locations were positioned to achieve good spatial coverage over the site and to obtain data representative of the high and low spots existing in the sediment cap at that time.

The 2007 sampling coordinates were based on the 2005 sampling event; however, it was expected that local currents and wave action may have resulted in a general smoothing of the topography over time. To achieve representative collections of ridge and valley locations, the vessel transited towards a target station on a heading that was perpendicular to the orientation of the ridges. As the target coordinates were approached the ridges and valleys were clearly discernable on the fathometer of the vessel. Depending on the station, either a valley or a ridge was targeted. As the appropriate feature emerged on the fathometer, a 10-lb lead weight attached to a line and surface float was thrown overboard to mark the feature. The vessel then transited back towards the location to confirm that the marker did, in fact, accurately mark the feature. If it did not, the method was repeated until successful (usually this was unnecessary). Once the feature was accurately marked, the surface grab sample was collected from that location and the actual sample coordinates were recorded. The surface 0.3 ft from each sample was homogenized and subsampled. One field replicate sample was also collected.

Boat House — Sediment cores were collected from 10 locations at the proposed Boat House area. Sediment cores were collected and processed as described in Sections 2.1.1 and 2.2, respectively. Sediment cores from multiple depth intervals were subsampled for PCB analysis. One sediment core was collected for replicate analysis.

2.2 Sample Processing

Sediment samples were kept on ice and transferred to the Sawyer Street trailer for processing, except for the progress-dredge cores which were processed on board the survey vessel and then discarded. Sediment samples were photo-documented, visually characterized, and subsampled for chemical and physical testing as described below. A summary of the samples collected is provided in Table 1.

Table 1. Sediment Samples Collected During the 2007 Sediment Monitoring Program. (a)

Sample Type	Number of Sediment Samples Collected		Number of Samples Sub-sampled for Chemical and Physical Testing				
	Sediment Cores	Sediment Grabs	PCB Congener	PCB Homologues	Grain Size	TOC	VOC
Pre-Dredge	50	0	0	0	0	0	0
Progress Dredge	135	0	0	0	0	0	0
Post-Dredge	55	0	38	4	38	38	2
OU3	0	17	18	2	0	0	0
Boat House	11	0	33	3	0	0	0

(a) Includes field replicates.

2.2.1 Photodocumentation

In general, previous investigations have shown that dark, high water content, organic silts in the surface sediment are associated with elevated PCBs (FWENC, 2001 and 2002; ENSR, 2004 and 2005). These sediments fall under the "OL" description in the USCS (organic silt, organic clay). At the Site these contaminated OL sediments generally overlie lighter colored, more consolidated native clays which have lower PCBs concentrations. The use of this visual transition as a general indicator of the vertical location of contamination provides a rapid and inexpensive method to assess dredge targets and performance.

To document this visual transition, all sediment cores were documented with digital photographs. Digital photographs of the cores were uploaded to the New Bedford Harbor project database. These photographs are linked in the database to the location information and to the analytical results and can be viewed individually. Each photograph contained the following elements in the frame:

- *The sediment core*. Photographing was done through the clear liner. Alternatively, for cores that were examined on deck with no collection of analytical subsamples, the cores were extruded from the core liner on deck for photographing. Also, for cores that did receive additional subsample processing, the core liners were cut open longitudinally to expose the sediment for sampling and photographing.
- *Measurement reference*. A tape measure (or equivalent) marked in decimal feet ran parallel to length of the core.
- *Sample identifier*. A card, paper, whiteboard, or equivalent was placed next to the core with the following written information:
    - Sample ID – an alpha numeric code that identifies sample matrix, sampling year, station location, and depth interval sampled
    - Sample Collection Date

2.2.2 Visual Characterization and Subsampling for Chemical and Physical Testing

Following photodocumentation, all sediment samples (cores, grabs) were visually characterized and subsampled for chemical and physical testing as described below. A summary of the samples collected for chemical and physical testing is provided in Table 1.

Each sediment core was visually characterized and physical characteristics, including material type, color, consistency, particle size, and odor, was documented on the Sediment Sampling Log forms. For sediment grabs, the material type was documented on the Sediment Sampling Log forms.

Pre-dredge Cores. The pre-dredge sampling plan included a subset of cores to be selected for PCB analysis. However, based on determinations by the project team (USACE NAE, Jacobs and Battelle) no samples were selected for analysis. Instead, each of the cores was archived frozen at the Site for possible analysis at a later date.

Progress-dredge Cores. Samples for chemical or physical testing were not required.

Post-dredge Cores. Sediment cores were subsampled for PCB congener, sediment grain size, and total organic carbon (TOC) analysis. Based on the visual characterization, a segment from top of the core to the visual interface was collected for analysis. A 6-inch segment below the visual interface was also sampled and archived frozen at the site for potential future analysis. The sediment was removed from the core using a disposable plastic spoon and homogenized in a disposable aluminum bowl. Dedicated processing equipment was used for each sample to minimize the potential for cross-contamination and reduce the use of solvents. Samples were collected into the appropriate containers and transferred on ice to Battelle. Samples for grain size and TOC analysis were shipped by overnight carrier to Applied Marine Sciences, of League, Texas. Samples for PCB analysis were transferred to the Battelle Laboratory Custodian. Copies of the sample field logs and custody records are maintained with the project files at Battelle.

A subset of the samples was also selected for PCB homologue analysis. The field team assigned samples for homologue analysis based on horizontal location within the sampling site to achieve a representative distribution of samples across the area.

Two sediment cores (one sample plus one replicate core) were also collected at station AA22, located within Area H but outside the area dredged, for volatile organic compounds (VOC) analysis (Table 1). The cores were cut open at the target sampling depth interval (0.2-0.3 ft from top of the core), and a 5-ml syringe was used to extract the sample for VOC analysis. For each sample, a series of subsamples were collected into pre-preserved vials prepared by the analytical laboratory (Alpha Woods Hole Group Laboratories). One vial contained methanol preservative, two of the vials contained deionized water preservative, and one vial contained no preservative. These replicate vials allowed the laboratory to select the appropriate sample based on interferences seen during the analysis.

OU3 Pilot Cap Sediment Grabs. The surface 0.3 ft from each sample was homogenized and subsampled for PCB congener analysis. A subset of the samples was also selected for PCB homologue analysis. Samples for PCB analysis were transferred to the Battelle Laboratory Custodian. Copies of the sample field logs and custody records are maintained with the project files at Battelle.

Boat House Cores. Each core was subsampled for PCB analysis. A total of three depth intervals were sampled, including 0-1 foot, 1-2 feet, and 2-3 feet. A subset of the samples was also selected for PCB homologue analysis. Samples for PCB analysis were transferred to the Battelle Laboratory Custodian. Copies of the sample field logs and custody records are maintained with the project files at Battelle.

2.3 Chemical and Physical Testing

Sediment samples (Table 1) were analyzed for PCB congeners and homologues, VOCs, grain size composition and TOC content as described below.

2.3.1 Polychlorinated Biphenyls

PCB analyses of post-dredge, OU3, and Boat House sediment samples were performed by Battelle, located in Duxbury, MA. Samples were air-dried overnight to ensure percent solids in the samples were >50%. Approximately 5 g of the air-dried sample was spiked with surrogates and extracted using Accelerated Solvent Extraction (ASE) following modified EPA Method 3545. The extracts were processed through activated copper for sulfur removal and then received disposable Florisil column clean-up. The post-Florisil extract was concentrated, fortified with internal standards (IS), and submitted for analysis.

All sample extracts were analyzed for the 18 NOAA PCB congeners using gas chromatography/ electron capture detection (GC/ECD) using dual column confirmation, following modified EPA Method 8082. Sample data were quantified by the method of internal standards, using the IS compounds. Positive congener results were confirmed by a secondary column confirmation analysis with the higher of the two results reported, unless analyst discretion required otherwise (e.g. the result without an interference signal was reported).

A sub-set of the samples were also analyzed for PCB homologues using gas chromatography/mass spectrometry (GC/MS), following modified EPA Method 8270C. Sample data were quantified by the method of internal standards, using the IS compounds.

PCB congener and homologue results are reported in mg/kg dry weight and to two significant figures in this report. Concentrations of total PCB were calculated using the congener and homologue results. First, total PCB was calculated as the sum of the 18 NOAA congeners multiplied by the project-specific factor of 2.6. Next, total PCB was calculated as the sum of the homologues. A value of zero (0) was used in the summation for non-detects.

A routine set of quality control (QC) samples were prepared with each batch of 20 or fewer project samples to monitor data quality in terms of accuracy and precision. Each batch of project samples included one method blank, one laboratory control sample (LCS), and one matrix spike and matrix spike duplicate (MS/MSD).

2.3.2 Volatile Organic Compounds

VOC analyses of the post-dredge sediment core (collected at station AA22, an area of the harbor that was not dredged) were performed by Alpha Woods Hole Labs in Mansfield, MA. Samples were extracted following EPA Method 5035 and analyzed by GC/MS following EPA Method 8260B. Results are reported in mg/kg dry weight.

One trip blank was also submitted along with the field samples. Laboratory-based QC samples included analysis of one method blank, one LCS and LCS duplicate, and one MS/MSD.

2.3.3 Grain Size and Total Organic Carbon

Grain size and TOC analyses of the post-dredge sediment cores were performed by Applied Marine Sciences, Inc. of League, TX. Grain size analyses were performed according to ASTM Method D422 and reported as percent gravel, sand, silt and clay. Quality control for grain size analyses included analysis of an analytical duplicate. Total Organic Carbon (TOC) was analyzed by EPA Method 9060 and reported as percent dry weight. Quality control for TOC included analysis of an analytical duplicate.

3.0 RESULTS

3.1 Field Activities

Results from the field activities conducted during the 2007 remedial dredge season are described below. Complete field data are documented on the Sediment Sampling Log forms provided in Appendix A. Digital photographs of the cores were uploaded to the New Bedford Harbor project database. These photographs are linked in the database to the location information and to the analytical results and can be viewed individually. Further details about dredging activities are provided in Jacobs (2008).

3.1.1 Dredging and Field Monitoring Summary

Dredging was conducted from August to October 2007. Dredging was performed at Area H, which encompasses sections of DMU-9 and DMU-10, and DMU-11 and Area G, which encompasses sections of DMU-1 and DMU-102. The eastern portion of Area G (in DMU-102) is intertidal. As a result, dredging could not always be conducted during lower tides. To maintain efficiency a second dredge was set up. When low water prevented dredging in Area G, dredge crews moved over to the second dredge. This approach meant that the dredging location was variable from day to day and even within days. Weekly bathymetric data and sediment core samples were collected to provide feedback to the dredge operators in areas where dredging had been conducted to determine the need for clean up passes. Based on these data, dredgers did not return to previously dredged areas to perform clean up passes. Dredging in Areas G and H was conducted in a North-South orientation during most of the dredging season. During the last two weeks of dredging at Area H, dredging was conducted East-West in the eastern portion of the dredge area only.

Dredging was performed using a Mud Cat™ hydraulic dredge equipped with a horizontal auger (Figure 9). The dredge was propelled by winching itself along a traverse cable which spans the dredge area to opposite sides of the perimeter cable. As a pass was completed, support crews relocated the cable to position for the next pass. The auger on the dredge is eight-ft wide. Six foot wide dredge passes were conducted. This provided two feet of overlap into the previous pass to capture any residual sediment which may have sloughed into the new cut. Dredge material was pumped through a pipeline to a booster pump, then to the desanding facility at Sawyer Street. Following desanding, the remaining fine material was pumped via a separate pipeline to the dewatering, treatment, and handling facility in the Lower Harbor. In total, the 2007 dredging removed over 23,300 cubic yards of material (Jacobs, 2008).

Figure 9. Mud CatTM Hydraulic Dredge.

The hydraulic dredge can not handle large debris which is common in this portion of the harbor. Debris removal was accomplished by 'raking' the bottom with a barge-mounted excavator

(Figure 10). Barges secured to the side of the debris removal platform stored the debris and were moved offsite as needed. Support boats were used throughout the operation to transport crews, maintain dredges, handle the pipeline, and move barges.

Dredging related sediment sampling included collection of sediment cores prior to, during and upon completion of dredging activities. In addition to these dredge related sampling events, sediment grab samples were collected at the OU3 Pilot Cap site outside the New Bedford hurricane barrier and sediment core samples were collected at the proposed Boat House location. Results from all of these sampling activities are provided below.

Figure 10. Debris Removal Excavator.

3.1.2 Pre-dredge Core Sampling

A total of 50 pre-dredge cores were collected at Area G (Figure 6) and Area H (Figure 7) in June and July, 2007. Core locations spanned the horizontal extent of the planned dredge areas. Results from the pre-dredge sampling effort consisted of vertical elevation data based on physical measurements and visual characterization of the sediment cores. Table 2 lists the relevant elevation data from the pre-dredge sampling event, including elevation of the visual transition and thickness of the OL layer. Figures 11 and 12 show the thickness of the OL layer overlayed on the target dredge elevations.

The physical characteristics of the pre-dredge cores were typical of sediments previously described at the site. The cores were generally comprised of two distinct layers. The surface layer is comprised of very fine-grained loose black organic silt with very high moisture content ('OL' in the USCS). This surface layer ranged from about 0.2 to 5.1-ft of OL (Table 2), with the thickest sediments found along the western shoreline of Area H (Figure 12). Below this OL layer the sediment type was generally moderately stiff olive-gray clay ('OH' in the USCS, defined as organic clay, organic silt). At Area G (upriver of Aerovox facility) the upper sediment layer was fairly uniform in thickness (Figure 11). At Area H (downriver of Aerovox facility) an increased sediment thickness was observed, which generally related to deeper target dredge elevation depths with thicker OL layers on the western side of the river (Figure 12). Elevation and sediment thickness data from the pre-dredge sampling was provided to NAE and Jacobs. These data were used to modify target dredge elevations for the final 2007 dredge plan (Jacobs, 2008).

Table 2. Elevation Data From the Pre-dredge Sampling Event.

Dredge Area	Station	Northing NAD 83 MA, ft	Easting NAD 83 MA, ft	Elevation of visual transition (native to OL) (NVGD, ft)	Thickness of Remaining Sediment (ft)
Area G	A14	2707464.30	815561.50	-2.40	0.90
	C16	2707387.11	815585.30	-2.40	1.30
	C5	2707673.60	815601.40	-3.40	0.60
	C9	2707562.30	815588.80	-4.30	1.00
	E1	2707762.50	815638.30	-1.80	0.20
	G20	2707289.56	815686.83	-4.40	1.90
	I4	2707689.90	815736.10	-1.90	1.10
	K1	2707776.10	815799.75	-1.90	1.30
	K18	2707343.84	815784.60	-3.40	1.50
	K9	2707582.87	815795.10	-2.10	1.10
	L13	2707465.40	815812.60	-2.90	1.40
	N4	2707703.10	815874.90	-2.20	1.40
	O19	2707310.65	815891.12	-2.90	0.60
	Q11	2707527.20	815938.30	-2.40	1.30
	Q16	2707387.30	815936.40	-2.90	1.30
	R1	2707762.50	815961.50	-1.80	1.20
	R19	2707337.70	815985.90	-2.60	0.80
	R4	2707698.80	815976.90	-2.10	1.40
	T20	2707283.63	816020.72	-3.20	1.00
	U12	2707487.50	816049.10	-2.20	0.90
	U16	2707388.20	816038.80	-2.30	0.90
	W20	2707288.30	816086.07	-3.40	1.10
Area H	AA22	2704885.60	815001.70	-7.90	4.90
	AAA28	2704737.92	815639.02	-3.70	0.90
	AAA39	2704465.60	815638.40	-2.70	0.80
	CC24	2704851.10	815050.10	-5.90	1.90
	DD31	2704673.70	815074.10	-7.20	2.60
	DD34	2704599.90	815073.40	-7.60	2.50
	DD37	2704523.50	815073.10	-7.90	2.70
	DD40	2704450.10	815074.80	-9.50	5.10
	FF23	2704876.90	815123.30	-5.50	0.90
	FF28	2704737.10	815111.20	-5.30	1.30
	GG33	2704624.80	815149.50	-5.30	1.00
	GG35	2704563.90	815138.40	-5.40	0.90
	II39	2704472.10	815200.90	-5.60	0.90
	JJ26	2704787.20	815212.70	-4.90	1.00
	KK32	2704649.80	815248.80	-5.30	1.00
	LL23	2704874.80	815273.60	-4.80	0.70
	MM25	2704812.10	815311.20	-5.00	1.00
	NN29	2704711.60	815311.90	-5.20	1.00
	NWC	2707630.40	815603.10	-3.90	0.50
	OO36	2704550.90	815350.30	-5.60	1.10
	QQ26	2704799.10	815386.90	-5.60	1.50
	QQ40	2704449.20	815399.60	-5.40	1.20
	SS23	2704875.90	815448.90	-4.60	0.70
	UU30	2704686.40	815487.30	-5.10	1.20
	UU35	2704562.90	815487.50	-4.90	1.00
	VV26	2704798.70	815524.80	-4.70	1.00
	ZZ23	2704862.20	815613.40	-4.00	0.70
	ZZ34	2704598.25	815623.50	-3.60	0.80

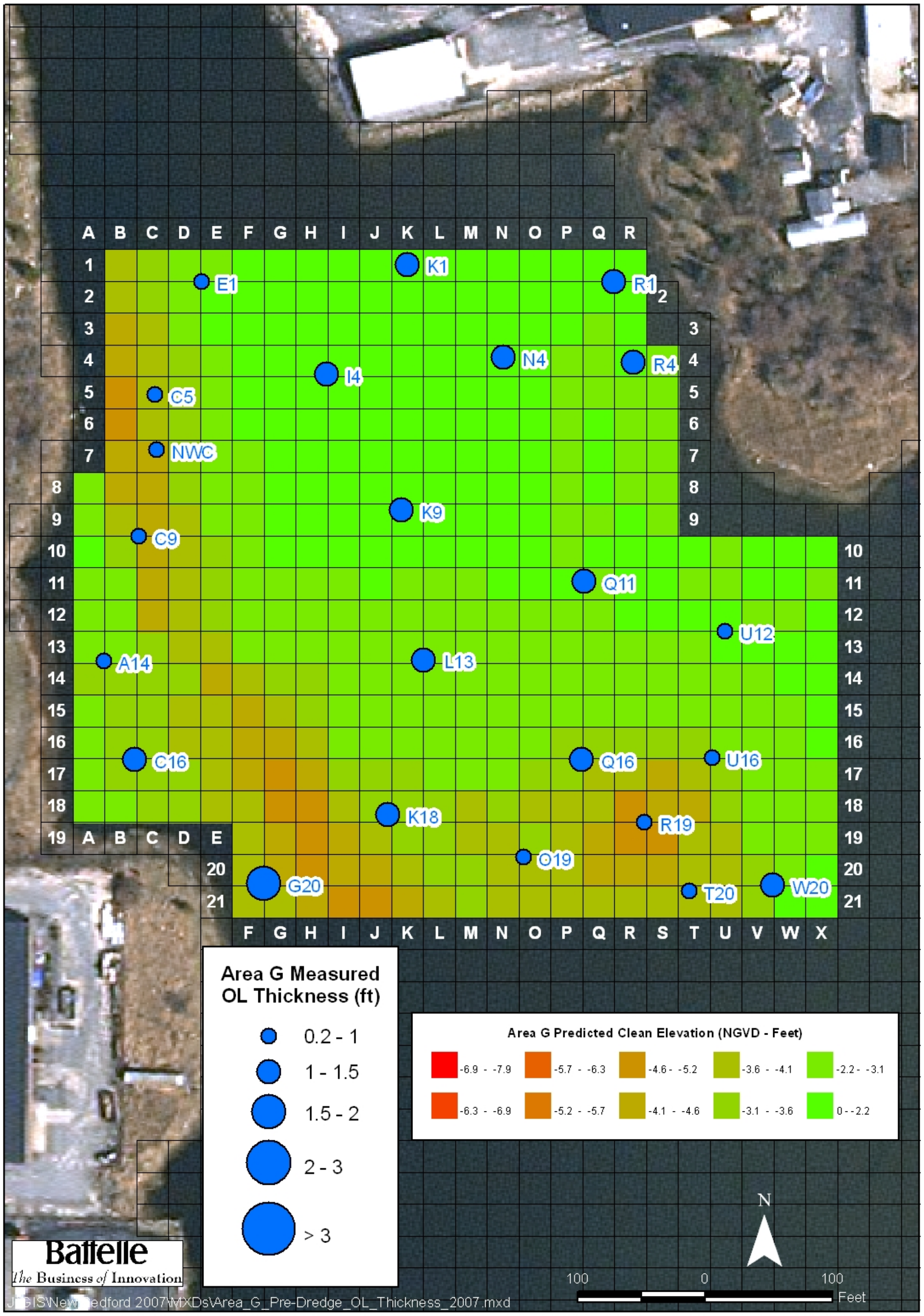

Figure 11. Pre-dredge Thickness of OL Layer at Area G.

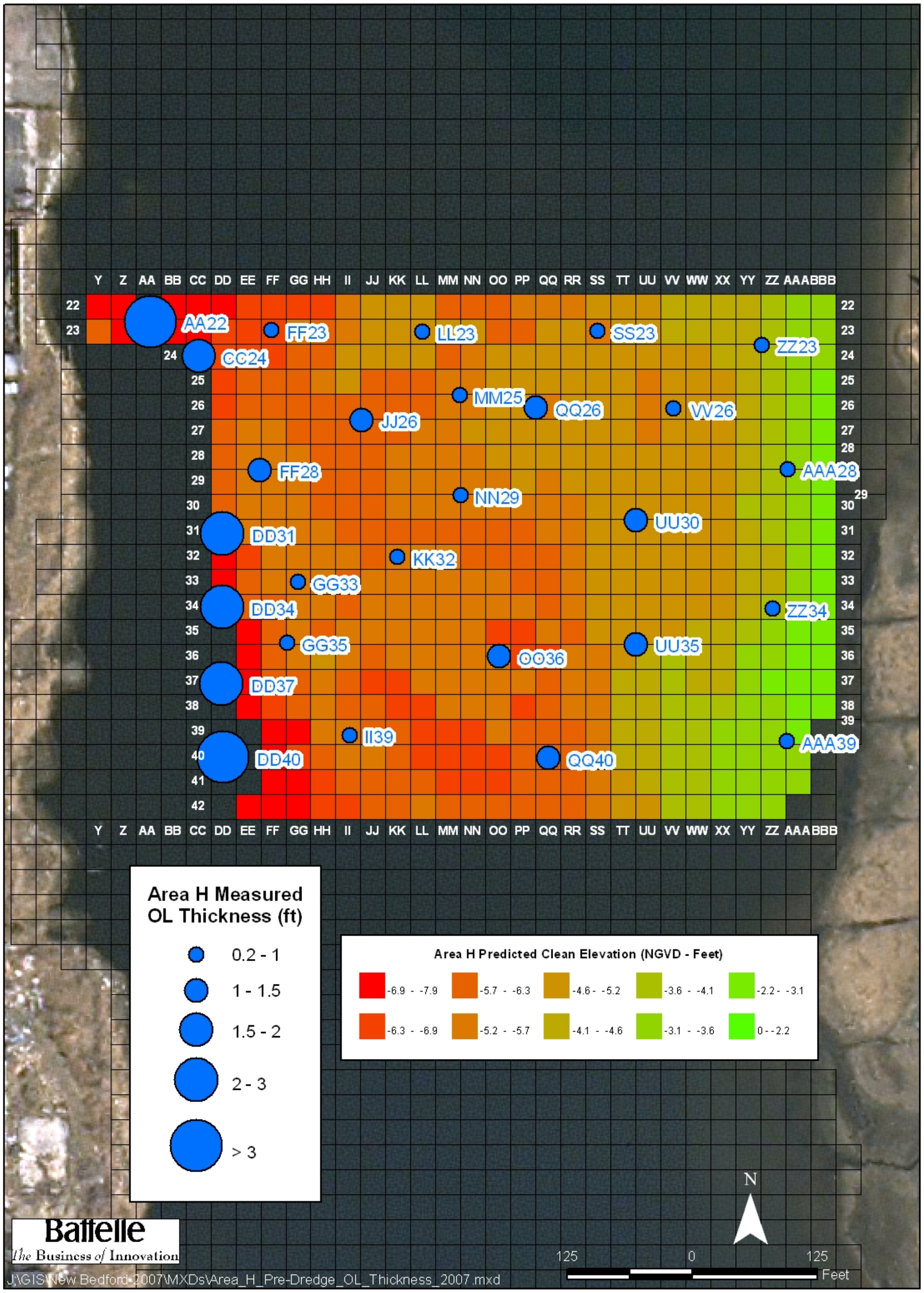

Figure 12. Pre-dredge Thickness of OL Layer at Area H.

3.1.3 Progress-dredge Sediment Sampling

Progress dredge samples were collected at Area G (Figure 6) and Area H (Figure 7) as needed during the 2007 dredge season to provide feedback regarding dredge progress and success. In general, progress-dredge sampling was conducted during each week of the dredge season, although during the early stages or when progress was slow, this sampling was not required. Progress-dredge core samples were processed (photodocumented and visually characterized) directly aboard the sampling barge for and then discarded.

Characterization and elevation measurements were targeted at identifying the elevation of the sediment-water interface and the visual transition from OL to OH. Elevation data for the progress-dredge cores are summarized in Table 3, and includes a comparison the actual vs. predicted transition elevation. This information was used by the dredge operators to confirm the amount and depth of remaining contaminated sediment. These elevation measurements were also useful in determining if areas were overdredged. Based on progress-dredge core results and the weekly bathymetric survey, dredge operators would have returned to areas to remove any remaining material, if needed. However, no additional passes were conducted during the 2007 dredge season.

Table 3. Elevation Data From the Progress-dredge Sampling Events.

Dredge Area	Station (Z Block)	Elevation Measurements (NGVD ft)			Measured Sediment Thickness Remaining (ft)	Actual vs. Predicted Transition Elevation (ft)
		Target Dredge Elevation	Measured Elevation of Visual Transition (Native to OL)	Measured Elevation of Sediment Surface		
Area G	H13	-2.8	-3.3	-1.9	1.4	-0.5
	H2	-1.6	-2	-1.9	0.1	-0.4
	I1	-1.6	-2.7	-2.3	0.4	-1.1
	I12	-2.7	-2.9	-2.4	0.5	-1.0
	I4	-1.6	-2.6	-2.3	0.3	-1.0
	I7	-1.9	-2.3	-2.1	0.2	-0.4
	J10	-2	-2.6	-1.9	0.7	-0.6
	J14	-2.7	-3.4	-2.9	0.5	-0.7
	J18	-3.3	-3.6	-3.1	0.5	-0.3
	J8	-2.1	-2.3	-2.1	0.2	-0.2
	K12	-2.6	-3.9	-2.6	1.3	-1.3
	K13	-2.7	-2.5	-1.8	0.7	0.2
	K16	-3	-3.5	-2.9	0.6	-0.5
	K19	-3.4	-3.9	-3.3	0.6	-0.5
	K2	-1.7	-3.1	-2	1.1	-1.4
	K21	-4.4	-5.3	-3.8	1.5	-0.9
	K5	-1.5	-3.3	-2.4	0.9	-1.8
	L3	-1.7	-2.9	-2.8	0.1	-1.2
	L7	-1.9	-3.1	-2.4	0.7	-1.2
	M12	-2.6	-3.8	-3.5	0.3	-1.2
	M12	-2.6	-4.2	-3.9	0.3	-1.6
	M13	-2.6	-2.9	-2.6	0.3	-0.3
	M15	-2.9	-3.9	-3.4	0.5	-1
	M17	-2.9	-4.4	-3.2	1.2	-1.5
	M20	-3.3	-4.5	-3.4	1.1	-1.2

Table 3. (cont)

Dredge Area	Station (Z Block)	Elevation Measurements (NGVD ft)			Measured Sediment Thickness Remaining (ft)	Actual vs. Predicted Transition Elevation (ft)
		Target Dredge Elevation	Measured Elevation of Visual Transition (Native to OL)	Measured Elevation of Sediment Surface		
Area G	M4	-1.7	-2	-2	0	-0.3
	M7	-1.9	-2.3	-1.7	0.6	-0.4
	N10	-2	-3.7	-3.2	0.5	-1.7
	N14	-2.8	-4.4	-3.9	0.5	-1.6
	N17	-2.9	-4.1	-3.8	0.3	-1.2
	N2	-1.5	-3.5	-3.3	0.2	-2
	N21	-3.8	-4.2	-3.7	0.5	-0.4
	N4	-1.7	-3.9	-3.1	0.8	-2.2
	N6	-1.8	-3.3	-3.2	0.1	-1.5
	N8	-2	-3.3	-3.1	0.2	-1.3
	O1	-1.4	-3.3	-2.8	0.5	-1.9
	O4	-1.8	-2.75	-2.7	0.05	-0.95
	O8	-1.9	-3.1	-2.8	0.3	-1.2
	P10	-2.5	-3.3	-2.9	0.4	-0.8
	P12	-2.2	-2.6	-2.4	0.2	-0.4
	Q3	-2.2	-3.6	-2.7	0.9	-1.4
	Q6	-2	-3.3	-3	0.3	-1.3
	Q9	-2.5	-3	-2.9	0.1	-0.5
Area H	AAA30	-3.3	-4	-3.3	0.7	-0.7
	BBB23	-3.1	-3.1	-2.4	0.7	0
	BBB27	-2.8	-3	-2.5	0.5	-0.2
	DD22	-7.2	-8	-6.6	1.4	-0.8
	DD24	-5.8	-7.3	-6.3	1	-1.5
	DD27	-5.8	-6.9	-6.1	0.8	-1.1
	DD31	-7.2	-8.1	-6.5	1.6	-0.9
	DD31	-7.2	-7.6	-5.6	2	-0.4
	DD32	-7.5	-10.4	-9.7	0.7	-2.9
	DD34	-8	-8.3	-7.4	0.9	-0.3
	DD35	-8.2	-10	-9.3	0.7	-1.8
	DD36	-8.5	-9.3	-8.3	1	-0.8
	DD40	-9.5	-10.6	-9.4	1.2	-1.1
	EE32	-6.6	-7.4	-6.1	1.3	-0.8
	EE41	-8.4	-9.4	-7.3	2.1	-1
	FF23	-6.3	-5.4	-4.9	0.5	0.9
	FF26	-5.9	-6.4	-5.8	0.6	-0.5
	FF28	-5.4	-5.3	-4.9	0.4	0.1
	FF34	-5.7	-7	-6.4	0.6	-1.3
	FF38	-6.3	-6.8	-6.2	0.6	-0.5
	GG25	-5.8	-5.8	-5.5	0.3	0
	GG29	-5.4	-5.5	-4.9	0.6	-0.1
	GG33	-5.5	-6.5	-5.4	1.1	-1
	GG33	-5.5	-6.3	-5.8	0.5	-0.8

Table 3. (cont)

Dredge Area	Station (Z Block)	Elevation Measurements (NGVD ft) Target Dredge Elevation	Measured Elevation of Visual Transition (Native to OL)	Measured Elevation of Sediment Surface	Measured Sediment Thickness Remaining (ft)	Actual vs. Predicted Transition Elevation (ft)
Area H	GG35	-5.6	-6.8	-6.1	0.7	-1.2
	GG38	-5.8	-6.9	-6.6	0.3	-1.1
	GG40	-6.4	-7	-6.1	0.9	-0.6
	HH22	-6.7	-6.7	-5.9	0.8	0
	HH28	-5.9	-6.4	-5.6	0.8	-0.5
	HH35	-6.1	-6.9	-6.4	0.5	-0.8
	HH37	-5.2	-6.4	-6.3	0.1	-1.2
	HH41	-6.4	-6.6	-6.2	0.4	-0.2
	HH42	-6.5	-7.3	-6.7	0.6	-0.8
	II25	-5.1	-6.6	-6	0.6	-1.5
	II31	-6	-6.4	-5.4	1	-0.4
	II35	-5.4	-6.7	-5.6	1.1	-1.3
	II39	-5.3	-6.9	-6.1	0.8	-1.6
	II41	-5.9	-6.7	-6	0.7	-0.8
	JJ23	-5	-6.6	-5.9	0.7	-1.6
	JJ26	-5.8	-6.3	-5.7	0.6	-0.5
	JJ29	-5.9	-7	-5.9	1.1	-1.1
	JJ33	-5.3	-7.2	-6.5	0.7	-1.9
	JJ42	-6.1	-7	-6.6	0.4	-0.9
	KK27	-5.9	-7	-5.8	1.2	-1.1
	KK32	-5.3	-7.7	-6.8	0.9	-2.4
	KK37	-6.3	-6.7	-6.4	0.3	-0.4
	LL26	-5.8	-6.2	-6	0.2	-0.4
	LL32	-5.3	-6.4	-5.7	0.7	-1.1
	LL33	-5.4	-6.6	-6.1	0.5	-1.2
	LL34	-5.5	-5.5	-5.2	0.3	0
	LL36	-5.5	-5.6	-5	0.6	-0.1
	LL36	-5.5	-6.8	-6.2	0.6	-1.3
	LL40	-6.3	-4.8	-4.6	0.2	1.5
	LL40	-6.3	-7.3	-6.3	1	-1
	LL42	-5.5	-4.2	-4.1	0.1	1.3
	MM22	-5.8	-7	-5.9	1.1	-1.2
	MM24	-5.7	-7.3	-6.2	1.1	-1.6
	MM29	-5.3	-6.5	-6.1	0.4	-1.2
	NN24	-5.6	-5.6	-5.1	0.5	0
	NN29	-5.3	-5.7	-4.8	0.9	-0.4
	OO26	-4.7	-6	-5.6	0.4	-1.3
	OO32	-5.9	-6.3	-5.1	1.2	-0.4
	OO38	-5.6	-7	-6.4	0.6	-1.4
	OO42	-6.2	-7.1	-6.2	0.9	-0.9
	PP22	-5.6	-5.9	-5.7	0.2	-0.3
	PP30	-5.3	-6.1	-5.4	0.7	-0.8

Table 3. (cont)

Dredge Area	Station (Z Block)	Elevation Measurements (NGVD ft) Target Dredge Elevation	Measured Elevation of Visual Transition (Native to OL)	Measured Elevation of Sediment Surface	Measured Sediment Thickness Remaining (ft)	Actual vs. Predicted Transition Elevation (ft)
Area H	PP36	-6.4	-6.5	-6.4	0.1	-0.1
	PP40	-6.2	-6.6	-6.4	0.2	-0.4
	QQ25	-4.6	-5.3	-4.8	0.5	-0.7
	QQ30	-5.2	-6	-5.4	0.6	-0.8
	QQ32	-5.7	-6	-5.6	0.4	-0.3
	QQ33	-5.7	-6.8	-6.6	0.2	-1.1
	RR22	-5.5	-5.4	-4.9	0.5	0.1
	RR27	-4.6	-5.2	-5	0.2	-0.6
	RR35	-5.8	-5.3	-5.1	0.2	0.5
	RR39	-5.8	-5.5	-5.1	0.4	0.3
	RR41	-5.9	-6.1	-5.6	0.5	-0.2
	SS23	-5.5	-6.1	-5.6	0.5	-0.6
	SS29	-5	-6.2	-5.4	0.8	-1.2
	SS38	-5.2	-5.6	-5.2	0.4	-0.4
	TT26	-5	-5.6	-5	0.6	-0.6
	TT30	-4.9	-5.6	-5	0.6	-0.7
	TT31	-5	-5.8	-5.2	0.6	-0.8
	TT36	-5	-5.3	-4.7	0.6	-0.3
	TT42	-5	-5.5	-4.8	0.7	-0.5
	UU22	-4.8	-5.4	-5.2	0.2	-0.6
	VV27	-4.6	-5.4	-5.1	0.3	-0.8
	WW24	-4.7	-5.4	-4.6	0.8	-0.7
	WW29	-4.7	-4.7	-4.7	0	0
	YY22	-4.1	-4.4	-4.3	0.1	-0.3
	YY28	-4.1	-4.9	-4.4	0.5	-0.8
	ZZ25	-3.7	-4.3	-4	0.3	-0.6

3.1.4 Post-Dredge Sediment Sampling

The post-dredge sampling event was conducted in November and December 2007 following the completion of dredge activities. This effort was conducted to verify the final sediment condition at the end of the 2007 dredge season. A total of 58 cores were collected during the post-dredge event at Area G (Figure 6) and Area H (Figure 7). Only six of the post dredge samples represented a revisit of pre-dredge locations for direct comparison of dredging performance. Table 4 lists the elevation data collected for the post-dredge core samples. Note that station AA22 was located just outside of the dredge area for 2007. Excluding station AA22, the average thickness of remaining contaminated sediment based on visual characterization of the post-dredge cores was 0.68-ft, with a range of 0.1 to 1.6-ft (Table 4).

The physical characteristics of the post-dredge cores had the same general characteristics as observed in the pre-dredge events. There were typically two distinct layers (OL overlying OH). However, as expected there were noticeable differences between the two events. As indicated by the elevation results discussed above, the overall thickness of the OL was clearly decreased following completion of dredge activities. The visual transition zone in many of the post-dredge cores was also noticeably different from the pre-dredge cores. There were fewer cores with sharp demarcations between the OL and OH layers, and these blurred transitions tended to be thicker (>0.5-ft) than observed in pre-dredge cores.

Table 4. Elevation Data From the Post-dredge Sampling Event.

Dredge Area	Station (Z Block)	Elevation Measurements (NGVD ft)			Measured Sediment Thickness Remaining (ft)	Actual vs. Predicted Transition Elevation (ft)
		Target Dredge Elevation	Measured Elevation of Visual Transition (Native to OL)	Measured Elevation of Sediment Surface		
Area G	I1	-1.60	-2.3	-1.80	0.50	-0.70
	I4	-1.60	-2.3	-1.60	0.70	-0.70
	I7	-1.90	-1.9	-1.80	0.10	0.00
	J10	-2.00	-2.9	-2.20	0.70	-0.90
	J10-DUP	-2.00	-2.8	-2.10	0.70	-0.80
	J14	-2.70	-3.5	-2.90	0.60	-0.80
	J18	-3.30	-3.1	-2.80	0.30	0.20
	K2	-1.70	-2.6	-1.80	0.80	-0.90
	K21	-4.40	-5.5	-4.30	1.20	-1.10
	K5	-1.50	-2.8	-2.20	0.60	-1.30
	M12	-2.60	-3.5	-3.10	0.40	-0.90
	M17	-2.90	-3.9	-3.30	0.60	-1.00
	M20	-3.30	-3.2	-2.90	0.30	0.10
	M7	-1.90	-2.2	-1.80	0.40	-0.30
	N10	-2.00	-2.9	-2.50	0.40	-0.90
	N14	-2.80	-4.3	-3.80	0.50	-1.50
	N4	-1.70	-3.6	-3.00	0.60	-1.90
	O1	-1.40	-3	-2.40	0.60	-1.60
	P12	-2.20	-2.5	-2.20	0.30	-0.30
	Q6	-2.00	-2.7	-2.50	0.20	-0.70
	Q9	-2.50	-3.1	-2.60	0.50	-0.60
Area H	AA22	-8.00	-7.3	-3.60	3.70	0.70
	AA22 DUP	-8.00	-7.4	-3.50	3.90	0.60
	BBB23	-3.10	-3.3	-2.40	0.90	-0.20
	BBB34	-2.90	-3.4	-2.30	1.10	-0.50
	DD22	-7.20	-7	-5.90	1.10	0.20
	DD24	-5.80	-6.9	-5.70	1.20	-1.10
	DD31	-7.20	-7.5	-6.50	1.00	-0.30
	DD36	-8.50	-9.1	-7.90	1.20	-0.60
	DD36 DUP	-8.50	-9	-7.70	1.30	-0.50
	DD40	-9.50	-10.5	-8.90	1.60	-1.00
	EE41	-8.40	-8.8	-7.40	1.40	-0.40
	GG29	-5.40	-5	-4.40	0.60	0.40
	GG33	-5.50	-6.3	-5.70	0.60	-0.80
	HH22	-6.70	-7.1	-6.10	1.00	-0.40
	HH42	-6.50	-6.9	-6.10	0.80	-0.40

Table 4. (cont)

Dredge Area	Station (Z Block)	Elevation Measurements (NGVD ft) Target Dredge Elevation	Measured Elevation of Visual Transition (Native to OL)	Measured Elevation of Sediment Surface	Measured Sediment Thickness Remaining (ft)	Actual vs. Predicted Transition Elevation (ft)
Area H	II25	-5.10	-6.2	-5.80	0.40	-1.10
	II36	-5.60	-6.5	-5.90	0.60	-0.90
	KK27	-5.90	-6.5	-5.60	0.90	-0.60
	KK32	-5.30	-6.9	-6.00	0.90	-1.60
	LL34	-5.50	-6.5	-6.40	0.10	-1.00
	LL40	-6.30	-6.7	-6.30	0.40	-0.40
	MM22	-5.80	-6.4	-5.90	0.50	-0.60
	MM29	-5.30	-7.8	-6.90	0.90	-2.50
	OO26	-4.70	-6	-5.30	0.70	-1.30
	OO32	-5.90	-6.1	-5.30	0.80	-0.20
	OO38	-5.60	-7	-6.50	0.50	-1.40
	OO42	-6.20	-6.6	-5.80	0.80	-0.40
	RR35	-5.80	-5.5	-5.20	0.30	0.30
	SS23	-5.50	-5.9	-5.60	0.30	-0.40
	SS29	-5.00	-6.1	-5.40	0.70	-1.10
	TT39	-4.50	-5.7	-5.40	0.30	-1.20
	VV34	-4.60	-5.2	-4.20	1.00	-0.60
	WW24	-4.70	-5.8	-5.00	0.80	-1.10
	WW29	-4.70	-4.8	-4.40	0.40	-0.10
	WW41	-3.70	-4.4	-3.80	0.60	-0.70
	XX37	-4.10	-5.1	-4.10	1.00	-1.00
	YY32	-4.50	-5	-4.80	0.20	-0.50

3.1.5 Harbor-wide Sampling

Sediment sampling was conducted at the OU3 Pilot Cap and proposed Boat House areas of the Harbor as described below.

OU3 Pilot Cap — Grab samples were collected at the OU3 Pilot Cap site in November 2007 from either ridge or valley locations as described in Section 2.2. Detailed bathymetry was conducted in 2005 and 2007 by Apex Engineering. It appears that there have been no substantive changes of the locations of these ridges and valleys since 2005. The physical characteristics of sediments from all locations sampled were generally similar. All of the samples had a thin (<1cm) light brown surface coating representative of an active algal layer. All samples were mostly fine sand. Based on the visual characterizations, the valley locations tended to have somewhat higher silt content than the ridge locations although this was not universally true.

Boat House — Sediment cores were collected in November 2007 at 10 locations offshore of the proposed Boat House location. Each sediment core was subsampled for PCB analysis at three depth intervals: 0-1 foot, 1-2 feet, and 2-3 feet, for a total of three samples per core. Most samples were comprised of black silt overlain by grey clay or sand (‘OL’ over ‘OH’ layer).

3.2 Chemical and Physical Testing

Results from the chemical and physical testing of sediment samples (Table 1) collected in support of the 2007 remedial dredge season are presented below. Complete test results are provided as appendices to this report. PCB results are provided in Appendix B, VOC results are provided in Appendix C, and sediment grain size and TOC results are provided in Appendix D.

3.2.1 Polychlorinated Biphenyls – Congeners

3.2.1.1 Post-dredge Sediments

Total PCB concentrations measured in post-dredge surface sediment samples collected at Areas G and H are summarized in Table 5. At Area G, total PCB concentrations ranged from 74 mg/kg to 660 mg/kg, with no clear distribution trend except that concentrations appeared to be lower in sediment sampled along the eastern boundary of the dredge area (Figure 13). At Area H, total PCB concentrations ranged from 5.4 mg/kg to 1,400 mg/kg, with the highest concentrations measured in fine-grained, organic-rich sediment sampled near the western boundary of the dredge area (Figure 14). Lower total PCB concentrations were measured in the sandy, low-TOC samples sampled near the eastern boundary at Area H (Figure 14).

Table 5. Total PCB in Post-dredge Sediment Samples, November and December 2007.

Area G			Area H		
Station ID	**Sample Depth Interval (ft)**	**Total PCB [a] (mg/kg dry)**	**Station ID**	**Sample Depth Interval (ft)**	**Total PCB [a] (mg/kg dry)**
N14-F07	0.0-0.5	74	WW24	0.0-0.8	240
I1	0.0-0.5	180	WW41	0.0-0.6	80
I4-F07	0.0-0.7	150	YY32	0.0-0.2	23
K2	0.0-0.8	100	BBB23	0.0-0.9	5.4
N4-F07	0.0-0.6	75	OO26	0.0-0.7	310
O1	0.0-0.6	660	OO32	0.0-0.8	280
Q9	0.0-0.5	100	OO38	0.0-0.5	160
J14	0.0-0.6	470	SS29	0.0-0.7	330
K5	0.0-0.6	250	VV34	0.0-1.0	370
J10	0.0-0.7	160	DD22[b]	0.0-1.1	540
J10 (dup)	0.0-0.7	160	GG29[b]	0.0-0.6	1400
K21	0.0-1.2	310	GG33-F07	0.0-0.6	300
M17	0.0-0.6	300	HH22	0.0-1.0	470
			II25	0.0-0.4	250
			II36	0.0-0.6	400
			KK32-F07	0.0-0.9	290
			LL40	0.0-0.3	190
			MM22	0.0-0.5	300
			MM29	0.0-0.9	270
			DD31-F07	0.0-1.0	1100
			DD36	0.0-1.0	1000
			DD36 (dup)	0.0-1.0	910
			EE41	0.0-1.4	590
			AA22-F07[c]	1.0-2.0	85
			AA22-F07[c] (dup)	1.0-2.0	96

[a b] Sum of 18 congeners x 2.6
[b] Target Dredge Elevation was not reached at this location
[c] Sediment was not dredged at this location

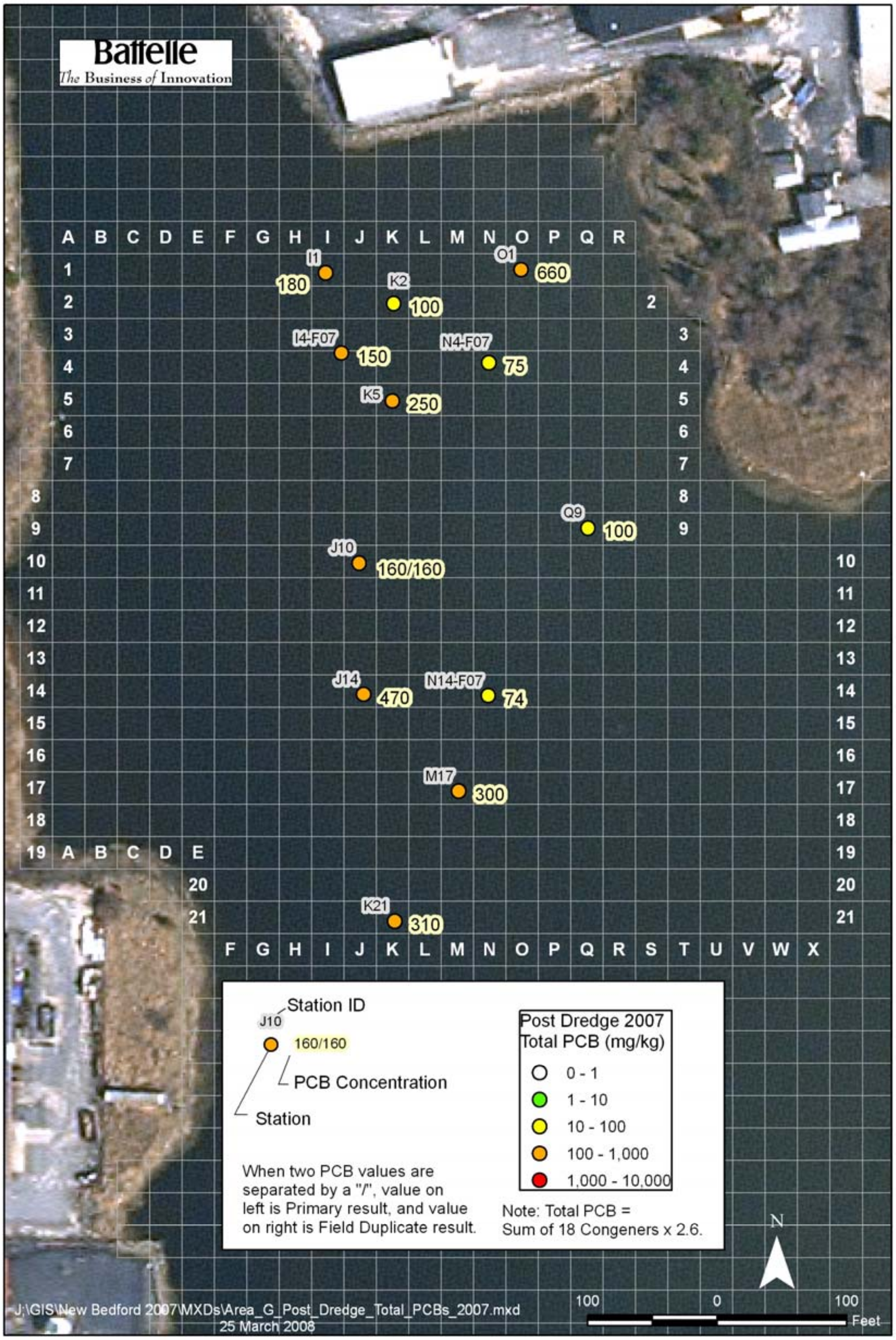

Figure 13. Total PCB in Post-dredge Sediment Samples at Area G, November and December 2007.

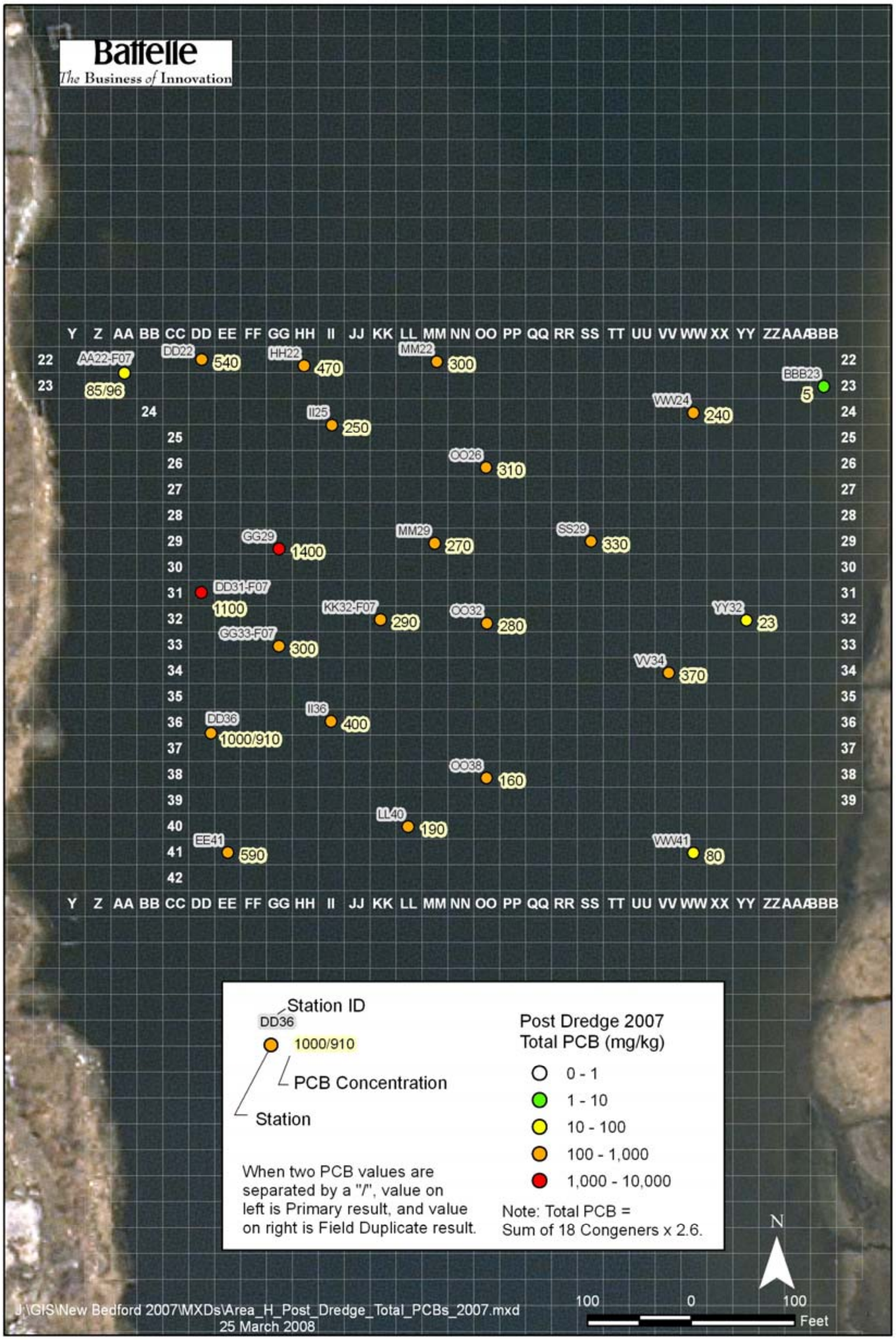

Figure 14. Total PCB in Post-dredge Sediment Samples at Area H, November and December 2007.

3.2.1.2 Harbor-wide Sediments

Total PCB concentrations measured in sediments at the OU3 Pilot Cap site and the proposed Boat House area of the Harbor in November 2007 are summarized in Table 6 and shown in Figure 15 (OU3 Pilot Cap) and Figure 16 (Boat House). Total PCB concentrations measured in surficial sediment (0-0.3 ft) samples at the OU3 Pilot Cap were fairly uniform across the spatial extent of the cap area, ranging from 0.24 mg/kg to 4.0 mg/kg (Table 6). Total PCB concentrations in surface (0-1 ft) sediments collected offshore from the proposed Boat House area ranged from 1.5 mg/kg to 250 mg/kg, and generally decreased with depth (Table 6, Figure 16). All but two of the deeper (>2-ft below surface) Boat House sediments had total PCB concentrations well below 1 mg/kg.

Table 6. Total PCB in OU3 Pilot Cap and Boat House Sediments, November and December 2007.

OU3 Pilot Cap			Boat House		
Station ID	Depth Interval (ft)	Total PCB [a] (mg/kg dry)	Station ID	Depth Interval (ft)	Total PCB [a] (mg/kg dry)
OU1	0.0-0.3	0.4	BH1	0.0-1.0	21
OU2	0.0-0.3	0.68		1.0-2.0	7.8
OU3	0.0-0.3	0.56		2.0-2.5	0.016
OU4	0.0-0.3	2.2	BH2	0.0-1.0	100
OU5	0.0-0.3	0.77		1.0-2.0	220
OU6	0.0-0.3	1.3		2.0-3.0	16
OU7	0.0-0.3	1.7	BH3	0.0-1.0	25
OU8	0.0-0.3	1.1		1.0-2.0	0.058
OU9	0.0-0.3	1.8		2.0-3.0	0.021
OU10	0.0-0.3	3.1	BH3 (dup)	0.0-1.0-REP	38
OU11	0.0-0.3	0.31		1.0-2.0-REP	0.2
OU12	0.0-0.3	2.8		2.0-3.0-REP	0.018
OU13	0.0-0.3	2.3	BH4	0.0-1.0	32
OU13 (dup)	0.0-0.3	1.3		1.0-2.0	6.4
OU14	0.0-0.3	1.8		2.0-3.0	4.2
OU15	0.0-0.3	3.1	BH5	0.0-1.0	29
OU16	0.0-0.3	4.0		1.0-2.0	0.38
OU17	0.0-0.3	0.24		2.0-3.0	0.04
			BH6	0.0-1.0	250
				1.0-2.0	120
				2.0-3.0	0.5
			BH7	0.0-1.0	19
				1.0-2.0	0.25
				2.0-3.0	0.012
			BH8	0.0-1.0	1.5
				1.0-2.0	0.26
				2.0-3.0	0.29
			BH9	0.0-1.0	190
				1.0-2.0	5.9
				2.0-3.0	0.13
			BH10	0.0-1.0	32
				1.0-2.0	0.82
				2.0-2.8	0.023

[a] Sum of 18 congeners x 2.6

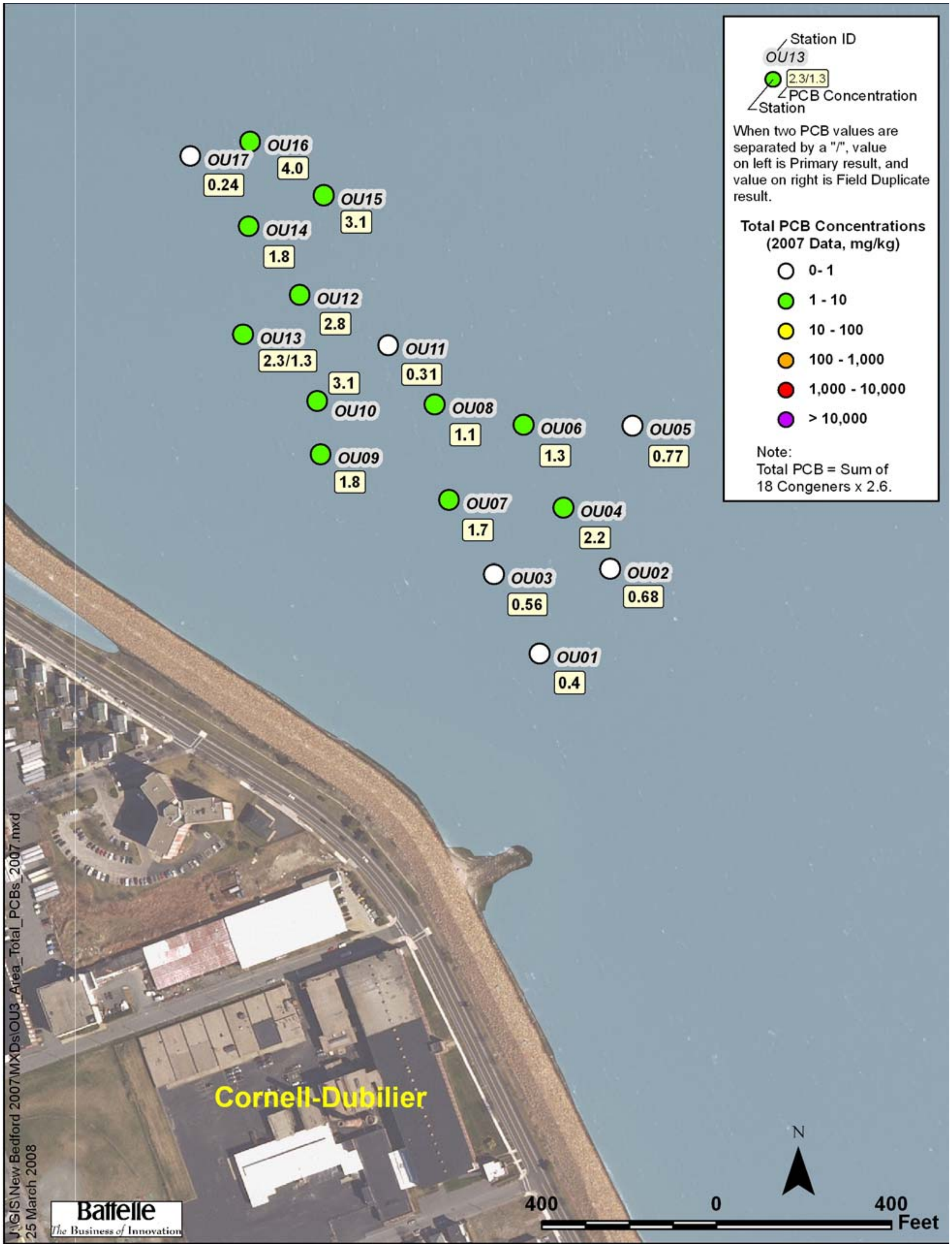

Figure 15. Total PCB in Surface Sediment at the OU3 Pilot Cap Site, November and December 2007.

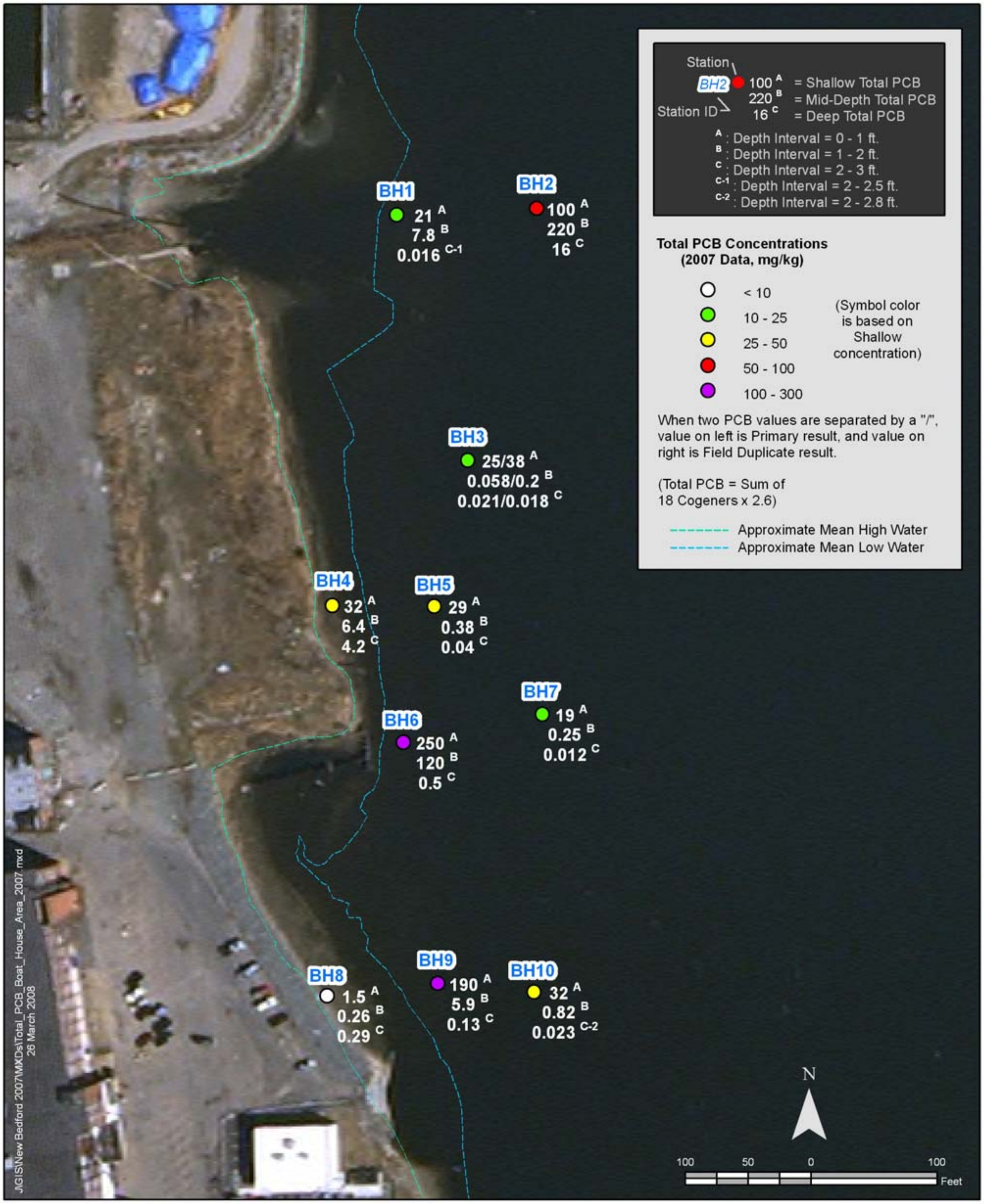

Figure 16. Total PCB in Sediment at the Boat House, November and December 2007.

3.2.1.3 Quality Control Results

Results from the field- and laboratory-based QC samples, described below, indicate that data quality is acceptable and the sample data are useable.

Field-based QC — Results from the field replicates for the post-dredge core, OU3 grab, and Boat House core samples were comparable. The relative percent differences (RPDs) between total PCB concentrations ranged from 0% to 12% for the post-dredge field replicates (Table 7), indicating representative samples were collected from a given location.

Total PCB concentrations between the field replicates collected at the OU3 Pilot Cap area were more variable (Table 7), which is probably associated with the overall lower concentration levels (<3 mg/kg).

Results from the replicate core sample collected at Boat House station BH3 were generally comparable. The RPDs between total PCB concentrations for the original and field replicate samples was 41% for the surface 0-1 ft sample, 110% for the 1-2 ft sample, and 15% for the bottom 2-3 ft sample (Table 7). The higher variability between total PCB concentrations for the 1-2 ft sample could be attributed to localized heterogeneity of the sediment material.

Table 7. Field Replicate PCB Results.

Sample Type and Area	Station ID	Sample Depth Interval (ft)	Total PCB [a] (mg/kg dry)		RPD
			Original	Field Duplicate	
Post-dredge, Area G	J10	0.0-0.7	160	160	0.0%
Post-dredge, Area H	DD36	0.0-1.0	1000	910	9.4%
	AA22-F07	1.0-2.0	85	96	12%
OU3 Pilot Cap	OU13	0.0-0.3	2.3	1.3	56%
Boat House	BH3	0.0-1.0	25	38	41%
		1.0-2.0	0.058	0.2	110%
		2.0-3.0	0.021	0.018	15%

[a] Sum of 18 congeners x 2.6

Laboratory-based QC — Results from the routine QC samples analyzed with each batch of project samples indicated that the laboratory methods were in control. The procedural blanks were free of contamination. PCB congeners were recovered within the control limits (40% to 120%) in the LCS samples. While some of the target PCB congeners were not recovered well in the MS/MSD samples, the recovery data met the contingency criteria. That is, PCB congener concentrations in the MS/MSD were less than five times background due to the naturally elevated PCB levels in the native samples, and, as a result, the QC recovery criteria was not applicable. Surrogate compounds were generally recovered within the control limits (40% to 120%), although for some samples the surrogates were slightly over-recovered probably due to interference from the highly-contaminated native samples. In general, the impact of these minor QC exceedences on the overall data quality is minimal.

3.2.2 Polychlorinated Biphenyls – Homologues

Approximately 10% of the sediment samples analyzed for PCB congeners were also analyzed for PCB homologues. A comparison of the total PCB concentrations, calculated using both the congener and homologue data, is summarized in Table 8. PCB results for the North of Wood Street samples, which are evaluated in Battelle (2008), are also reported in Table 8. In general, total PCB concentrations calculated by the two methods are comparable. Samples with low concentrations of total PCB showed greater variability between the two measurements, whereas samples with higher concentrations (>5 mg/kg) agreed well. Neither the congener or homologue method consistently resulted in higher total PCB values, although the homologue method did frequently result in higher PCB concentrations for the more contaminated samples (>100 mg/kg) (Table 8).

Table 8. Total PCB Concentrations Calculated by Congener and Homologue Methods.

Sampling Area	Depth Interval (ft)	Total PCB (mg/kg dry)		RPD
		Sum 18 Congeners[a]	Sum Homologue[b]	
Boat House	0.0-1.0	1.5	2.2	38%
	1.0-2.0	0.26	0.28	7.4%
	2.0-3.0	0.29	0.071	121%
Post Dredging (Area G)	0.0-0.5	100	110	9.5%
	0.0-0.6	300	320	6.5%
Post Dredging (Area H)	0.0-0.9	270	290	7.1%
	0.0-1.4	590	620	5.0%
OU3	0.0-0.3	1.8	1.1	48%
	0.0-0.3	4	2.6	42%
North of Wood Street	0.0-0.5	7.4	6.9	7.0%
	0.0-0.5	29	30	3.4%
	0.0-0.5	270	160	51%

[a] Sum of 18 congeners x 2.6, non-detect = 0 mg/kg.
[b] Sum of 10 homologue groups, non-detect = 0 mg/kg

3.2.3 Volatile Organic Compounds

Complete test results for the single post-dredge core sample and field duplicate collected at station AA22 (Area H) are provided in Appendix C. Target VOCs were undetected in the post-dredge core sample, except for carbon disulfide and 2-butanone which were detected at low concentrations (<0.1 mg/kg dry).

Results from the field- and laboratory-based QC samples indicate that the sample data may be biased low.

Field-based QC — The precision between detected concentrations of VOCs in the field replicates was variable (40% and 55% RPD, see Appendix C). However, VOC concentrations were low in the field replicates which can contribute to the higher variability. Two common laboratory contaminants, acetone and methylene chloride, were detected in the trip blank. This resulted in positively-detected acetone results being "U" (non-detect) qualified in the two field samples. Methylene chloride was not detected in either sample.

Laboratory-based QC — Sample data may be biased low for some compounds and high for others based on the surrogate, LCS/LCSD, or MS/MSD results, as summarized below (see Appendix C for complete details). Sample data that are biased low or high are qualifed (“J’ or “R”) on the final data reports. Among the main contaminants of concern (i.e., trichloroethene, cis-1,2-dichloroethene, and vinyl chloride) there were no QC exceedances for cis-1,2-dichloroethene or vinyl chloride, whereas trichloroethene was under-recovered (53% and 58%) in the MS/MSD.

- Sample data for many of the target VOC compounds may be biased low because the compounds were under-recovered (<70%) in the MS/MSD samples. VOCs were generally recovered well in the LCS/LCSD, suggesting that the lower recoveries in the MS/MSD could be matrix related or associated with the low solids content (38.2%) of the native sample. While VOCs are not typically detected in marine sediment, the low bias evident by the MS/MSD results may have contributed to a higher frequency of non-detects in the two project samples.
  - For VOCs recovered between 10% and 70% in the MS or MSD sample, results in the native sample were qualified with a “J”, indicating results were estimated.
  - For VOCs recovered below 10% (cis-1, 3-dichloropropene, hexachlorobutadiene, trans-1, 3-dichloropropene, vinyl acetate, and 1, 2, 3-trichlorobenznee), results in the native sample were rejected (qualified with an “R”).
- Sample data for 1, 2-dichloroethane may be biased high based the elevated recovery of the surrogate compound 1, 2-dichloroethane-d4 (136% vs. upper QC limit of the 130%) in one sample. The impact to data quality, however, is minimal because this compound was undetected in the project samples.
- Sample data for 1,1-dichloroethene may be biased high because it was over-recovered (137%) in the LCSD. The impact to data quality, however, is minimal because this compound was undetected in the project samples. Moreover, this compound was recovered within the acceptance limits in the MS/MSD samples.
- Sample data for 2-butanone may be biased high because this compound was over-recovered (131%) in the LCSD sample. The impact to data quality, however, appears to be minimal because this compound was recovered within the acceptance limits in the MS/MSD samples.

3.2.4 Grain Size and Total Organic Carbon

Grain size and TOC results for the post-dredge sediment samples collected at Areas G and H are summarized in Table 9.

3.2.4.1 Sediment Grain Size

Grain size results were consistent with the sediment type observed during field collections, in that most surface samples were comprised of silty sediments (the majority of the samples had >80% fines). Silt was the predominant grain size fraction in all but four of the post-dredge sediment samples (sand was the predominant grain size fraction at stations K2, BBB23, WW41, and YY32; see Table 9). Grain size composition in surface sediments at Area G was dominated by silt, followed by roughly similar percentages of clay and sand for most samples. Grain size composition in surface sediments at Area H was dominated by silt, followed by clay and sand. All surface sediments had very low percentages of gravel (<7%).

3.2.4.2 Total Organic Carbon

TOC values ranged from 0.57% at station BBB23 to 14.89% at station AA22 (Table 9), and were frequently above 6% in most surface sediments.

Table 9. Post-dredge Sediment Grain Size and TOC Results, November and December2007.

Dredge Area	Station ID	Depth Interval (ft)	Sediment Grain Size Fraction (% dry)					TOC (% dry)
			Gravel	Sand	Clay	Silt	Fines[a]	
Area G	I1	0.0-0.5	0.00	12.23	29.35	58.42	87.77	9.49
	I4	0.0-0.7	0.00	21.12	30.66	48.22	78.88	7.55
	J10	0.0-0.7	0.00	22.56	22.31	55.13	77.44	8.65
	J10 (dup)	0.0-0.7-REP	1.66	11.16	26.04	61.14	87.18	11.02
	J14	0.0-0.6	0.00	12.95	24.94	62.11	87.05	7.99
	K2	0.0-0.8	0.00	42.39	21.75	35.86	57.61	5.20
	K5	0.0-0.6	0.63	27.51	23.93	47.93	71.86	8.21
	K21	0.0-1.2	0.00	26.65	25.82	47.53	73.35	3.90
	M17	0.0-0.6	0.00	16.1	26.28	57.62	83.9	7.74
	N4	0.0-0.6	0.00	20.98	20.63	58.39	79.02	6.71
	N14	0.0-0.5	0.00	21.88	24.29	53.83	78.12	8.28
	O1	0.0-0.6	0.00	33.25	26.51	40.24	66.75	10.02
	Q9	0.0-0.5	0.00	12.43	30.05	57.52	87.57	7.61
Area H	BBB23	0.0-0.9	6.87	86.07	2.89	4.17	7.06	0.57
	DD22	0.0-1.1	0.00	7.87	32.77	59.36	92.13	8.70
	DD31	0.0-1.0	2.35	4.95	35.86	56.84	92.7	11.36
	DD36	0.0-1.0	0.00	4.82	36.04	59.14	95.18	12.50
	DD36 (dup)	0.0-1.1-REP	0.63	3.65	34.05	61.67	95.72	11.60
	EE41	0.0-1.4	0.00	5.53	40.24	54.23	94.47	11.47
	GG29	0.0-0.6	0.00	16.93	34.42	48.65	83.07	10.64
	GG33	0.0-0.6	0.21	13.04	37.29	49.46	86.75	5.45
	HH22	0.0-1.0	0.09	3.66	36.64	59.61	96.25	6.81
	II25	0.0-0.4	2.78	14.16	35.84	47.22	83.06	5.44
	II36	0.0-0.6	0.00	7.01	34.73	58.26	92.99	6.95
	KK32	0.0-0.9	0.00	4.96	36.32	58.72	95.04	6.07
	LL40	0.0-0.3	1.45	15.07	27.07	56.41	83.48	4.53
	MM22	0.0-0.5	0.00	3.75	37.00	59.25	96.25	6.19
	MM29	0.0-0.9	1.23	7.88	35.46	55.43	90.89	6.08
	OO26	0.0-0.7	2.20	15.59	35.79	46.42	82.21	6.04
	OO32	0.0-0.8	5.13	11.56	31.58	51.73	83.31	5.47
	OO38	0.0-0.5	0.00	12.84	39.52	47.64	87.16	4.50
	SS29	0.0-0.7	1.37	18.46	33.42	46.75	80.17	5.40
	VV34	0.0-1.0	0.00	16.95	37.06	45.99	83.05	6.38
	WW24	0.0-0.8	0.10	30.2	31.25	38.45	69.7	4.97
	WW41	0.0-0.6	3.37	63.14	12.82	20.67	33.49	2.64
	YY32	0.0-0.2	2.74	66.82	14.46	15.98	30.44	1.56
	AA22	1.0-2.0	0.00	13.16	26.77	60.07	86.84	14.89
	AA22 (dup)	1.0-2.0-REP	0.00	14.2	25.40	60.40	85.8	14.64

[a] Fines = sum of silt and clay fractions.

3.2.4.3 Quality Control Results

Results from the field- and laboratory-based QC samples, described below, indicate that data quality is acceptable and the sample data are useable. Sediment grain size and TOC analyses were not planned for the 2007 dredge season, and, as a result, acceptance criteria for field- and laboratory-based QC samples are not defined in the project QAPP (Battelle, 2006a). Acceptance criteria of #50% RPD and #25% RPD were used to evaluate field- and laboratory-replicate QC results, respectively. The field-replicate precision criterion (#50% RPD) is based on criteria defined in the QAPP Addendum (Battelle, 2008) for other parameters (e.g., PCBs, TSS). The laboratory-replicate precision criterion (#25% RPD) is based on criteria defined by the laboratory.

Field-based QC —Results from the field replicate samples collected at stations J10, DD36, and AA22 were generally comparable. For sediment grain size, field replicate measurements agreed well for clay and silt fractions (RPDs < 15%) and were more variable for sand (RPDs ranged from 8% to 68%) and gravel (RPDs>200%) fractions (Table 10). The poor precision between replicate gravel measurements is attributed to the very low percentages measured in the sediment samples. For TOC, field duplicates agreed well with RPDs ranging from 2% to 24% (Table 10). Overall, the field replicate results suggested that representative samples were collected from a given location.

Table 10. Field Replicate Grain Size and TOC Results.

Sample Type and Area	Station ID	Sample Depth Interval (ft)	Parameter	Value (% dry)		RPD
				Original	Field Duplicate	
Post-dredge, Area G	J10	0.0-0.7	Gravel	0.00	1.66	200%
			Sand	22.56	11.16	68%
			Clay	22.31	26.04	15%
			Silt	55.13	61.14	10%
			TOC	8.65	11.02	24%
Post-dredge, Area H	DD36	0.0-1.0	Gravel	0.00	0.63	200%
			Sand	4.82	3.65	28%
			Clay	36.04	34.05	5.7%
			Silt	59.14	61.67	4.2%
			TOC	12.50	11.60	7.5%
	AA22	1.0-2.0	Gravel	0.00	0.00	N/A
			Sand	13.16	14.2	7.6%
			Clay	26.77	25.40	5.3%
			Silt	60.07	60.40	0.5%
			TOC	14.89	14.64	1.7%

Laboratory-based QC — Three laboratory duplicates were analyzed as laboratory QC samples. RPDs between the parent and laboratory duplicate samples were all less than 10% for the grain size and TOC analyses, indicating the precision of the analyses was in control.

4.0 DISCUSSION

4.1 Vertical Elevation Results Related to Dredging

The collection of pre-dredge core samples for visual characterization provided information necessary for effective dredge planning. Site-wide geostatistical modeling based on historical PCB data has been used to develop an estimation of the vertical elevation of PCB contamination in the sediments (target dredge elevation). The dredge plan for each year is based on the target dredge elevations and contours within the planned footprint of dredging. Changes in sediment condition over time or uncertainties in the model can result in a discrepancy between the target dredge elevation estimates and the existing features at the site. Elevation data based on visual characterization of cores collected in June 2007 were used to refine the dredge plan in terms of target dredge depths and thickness of the OL layer. These data were used to refine the dredge plan and as a result target dredge depths were reduced, thereby reducing dredging and disposal efforts. However, these adjustments were strictly based on the visual characterization of sediments and the transition from black silt (OL layer) to native clays (OH layer). As the remediation project continues, the relationship of this visual characterization to actual PCB concentrations will need to be continually reevaluated. At this point in the program, this method appears to be a relatively inexpensive and simple means to determine dredge depths thus maximizing funding towards remedial efforts.

During the course of dredging operators use benchmarked dGPS information for horizontal and vertical control. This allowed for accurate dredging operations and minimized both ineffective under-dredging and expensive over-dredging. However, variables such as wind and debris can result in incomplete dredging along dredge lines. The use of weekly bathymetric surveys and sediment core collections served as good checks for dredge performance and provided feedback to operators regarding areas that may require an additional dredge pass.

The collection of post-dredge cores provided a characterization of the post-dredge sediment condition relative to the pre-dredge condition as well as setting a baseline for recently dredged areas. This baseline informs the planning process for subsequent years and provides feedback regarding redeposition of sediments as a result of dredging or natural processes. Comparison of the visual characterization of the pre and post-dredge cores revealed that the depth of the sediment surface and the overall thickness of OL layers were reduced across all dredged regions. These were clear and expected results of the dredging. Other post-dredge observations related to the visual transition between sediment types were also apparent. For example, in many cases the post-dredge cores had less distinct visual transitions. In these cases the transitions occurred over a relatively broad band (>0.5-ft) of mixed sediment. In most of these cases it appeared that the visual transition zone may have been disturbed during dredge related activities. In most cases (50 out of 56), the elevation of the post-dredge visual transition also occurred at a deeper elevation than predicted. Overall it appears that dredging activity resulted in an increase in the target dredge elevation (mean = -0.73-ft, median = -0.70-ft).

For the 2007 program very few of the pre-dredge sampling stations were visited for post–dredge confirmation. Instead, post-dredge sampling locations were chosen based on areas of specific concern to determine final dredge performance. As a result the pre-post comparison made in previous seasons is inappropriate for these data. Nor can a pre-post comparison of PCB data be performed because the pre-dredge cores from 2007 were not analyzed for PCBs.

4.2 Relationship Between Sediment Properties and Total PCB in Post-Dredge Samples

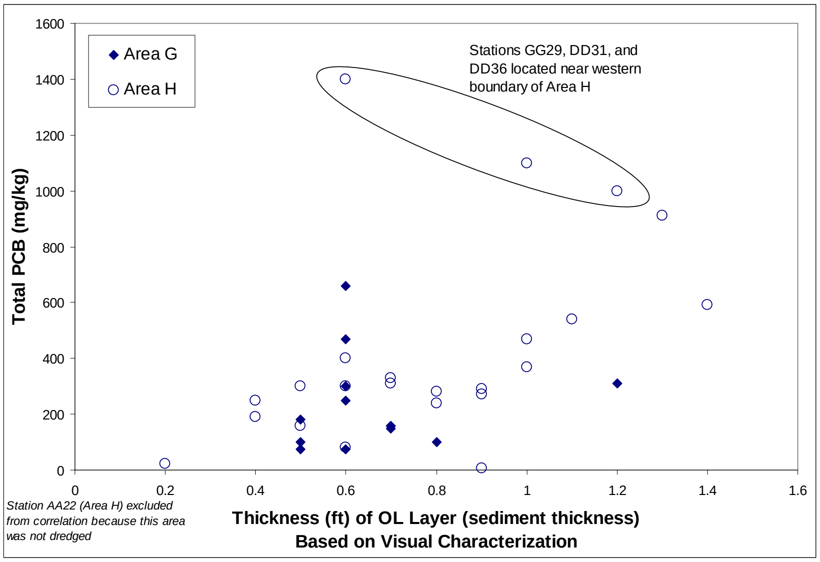

Figure 17. Correlation between Sediment Thickness and Total PCB in Post-dredge Surface Sediments, November 2007.

Total PCB concentrations in post-dredge surface sediments did not correlate with the thickness of the OL layer (amount of contaminated sediment remaining above the visual transition layer), especially at Area G (Figure 17). At Area H, the correlation is significant ($p < 0.001$, $r^2 = 0.5$) only if the highly-contaminated (total PCB >1000 mg/kg) samples near the western boundary of the dredge area are excluded from the correlation. The thickness of the remaining OL layer at these western boundary locations was variable (Figure 17). Small amounts of dredge residuals and/or small-scale heterogeneity may have contributed to the elevated PCB signal at these locations.

Generally, increasing levels of organic carbon in marine sediments correlate with increasing amounts of fine-grained sediment fractions (i.e., silt and clay). Percent fines and TOC, however, were not strongly correlated in post-dredge surface sediments sampled at Area G (Figure 18). The poor correlation may be attributed to potential sediment mixing during dredging or an artifact of the narrow range in sediment types sampled (see Table 9, percent fines ranged from 58% to 88%). At Area H, where there was a wider range of sediment types (sandy to silty sediments with wide range of TOC values), the correlation between percent fines and TOC was significant ($p = 0.001$, $r^2 = 0.38$; Figure 18), albeit the r^2 value was not particularly strong.

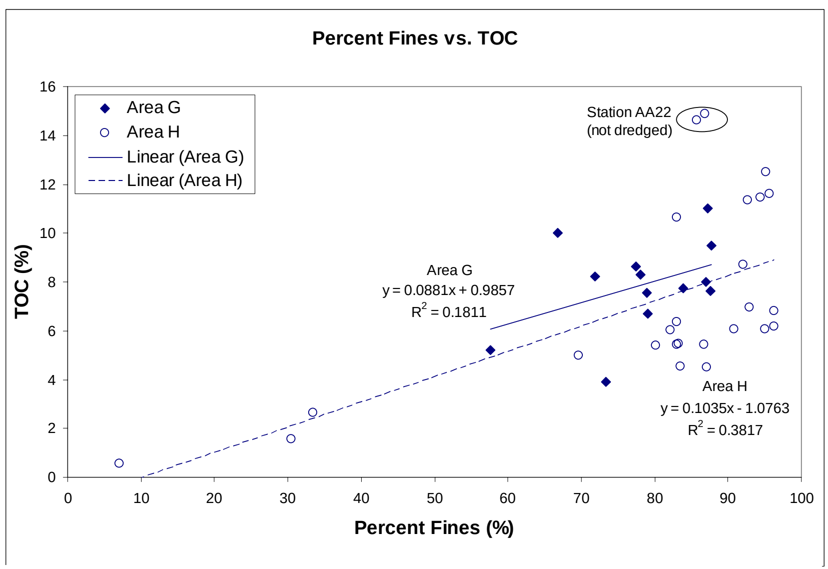

Figure 18. Correlation between Percent Fines and TOC in Post-dredge Surface Sediments, November 2007.

Total PCB concentrations did not correlate well with percent fines or TOC in post-dredge surface sediments sampled at Area G (Figure 19). The poor correlation may be associated with sediment condition (e.g., mixed, disturbed sediments) and/or the narrow range of sediment types sampled. Dredging and debris removal activities could potentially cause localized resuspension and redeposition of heterogeneous sediments with varying contamination history, resulting in sediment mixing in both horizontal and vertical directions. For instance, the fine-grained, less contaminated, deep sediments could have become resuspended to varying degrees, mixing with the more contaminated surface sediments with higher TOC.

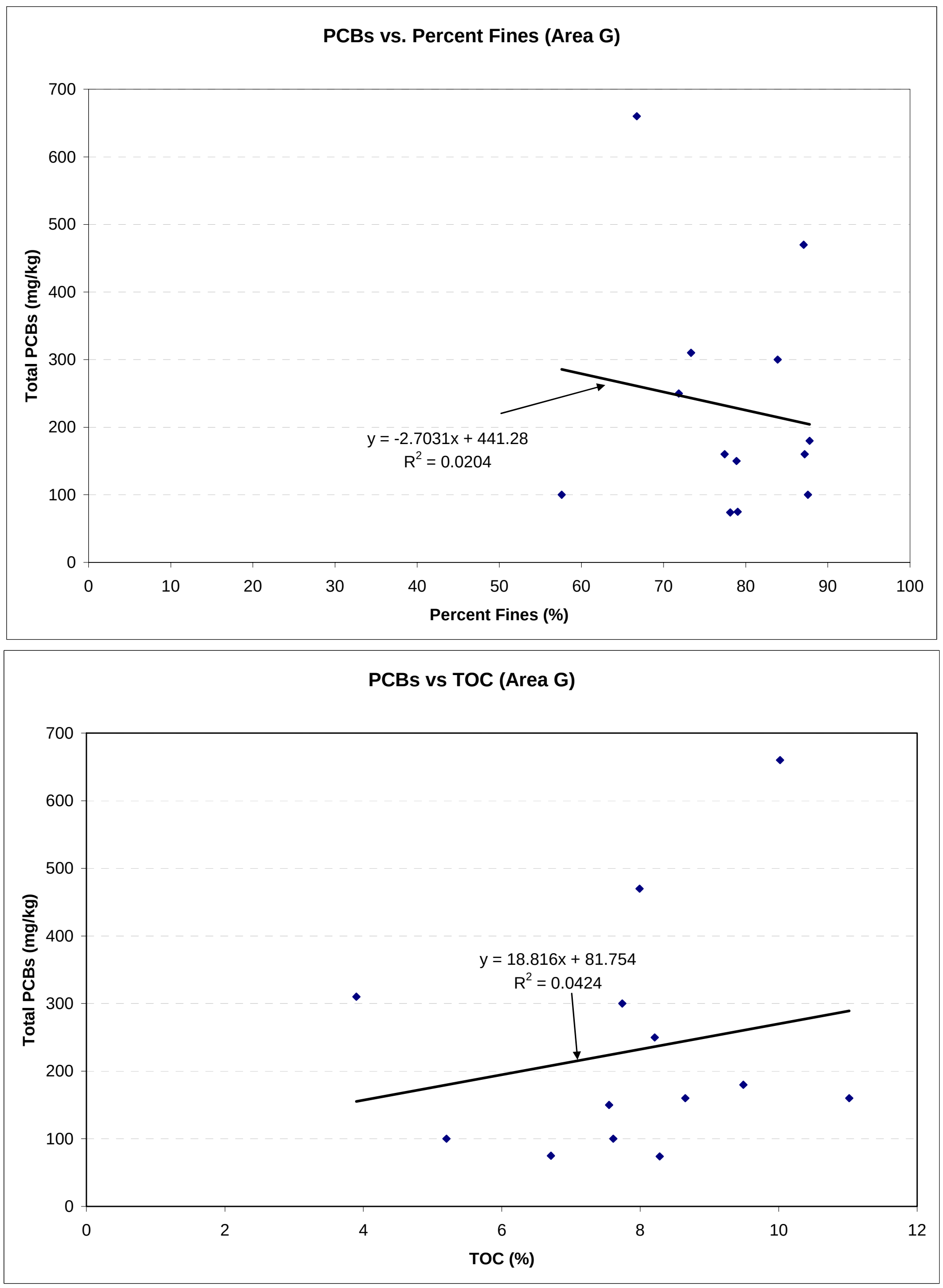

Figure 19. Correlation between Percent Fines and Total PCB (top) and TOC and Total PCB (bottom) in Post-dredge Surface Sediments at Area G, November and December 2007.

As was observed at Area G, total PCB concentrations in post-dredge surface sediments sampled at Area H did not correlate well with percent fines (Figure 20). The correlation against TOC, however, was significant (p = 0.006, r^2 = 0.8; Figure 20) which is not surprising because it is the organic content of the sediments that often influences chemical concentrations in the sediments (Hunt, 1979, Dayal *et al.*, 1981; 1983, Krom *et al.*, 1985, USACE, 1996). These results suggest that the surface sediments at Area H may be more homogenous compared to Area G, and that the contamination is influenced by the organic carbon content rather than sediment grain size.

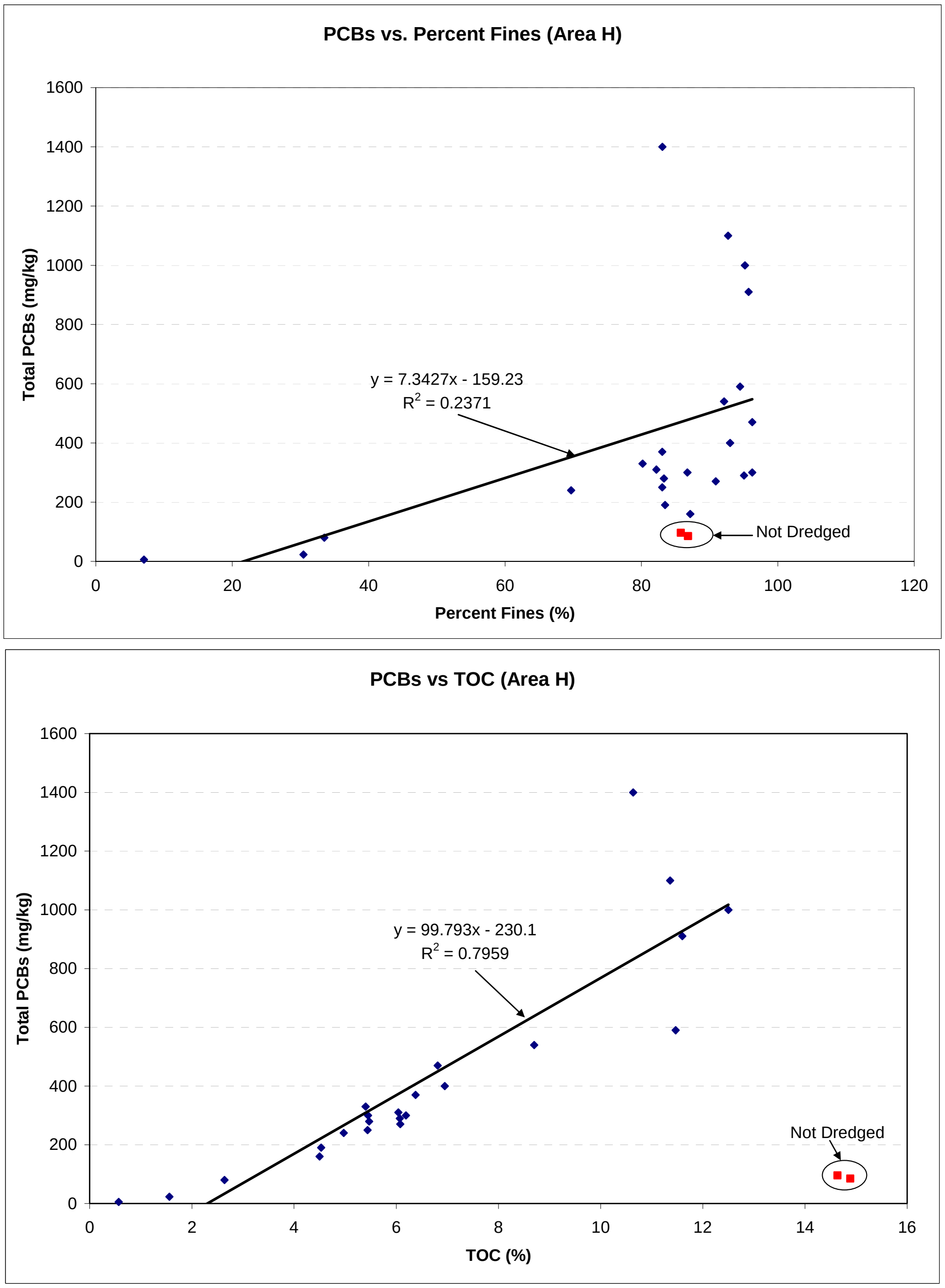

Figure 20. Correlation between Percent Fines and Total PCB (top) and TOC and Total PCB (bottom) in Post-dredge Surface Sediments at Area H, November and December 2007. (Sediments sampled at Station AA22, which was not dredged, were excluded from the correlation)

4.3 Temporal Trends in Total PCB at the OU3 Pilot Cap Site

The OU3 Pilot Cap site is a localized area of elevated PCB concentrations located outside the hurricane barrier in New Bedford, MA (Figure 2). In 2005 this area was capped with parent material dredged during the construction of a CAD cell in New Bedford Harbor. Annual monitoring has been performed since 2005 (shortly after completion of the capping activity) to determine the effectiveness of cap placement in lowering surficial sediment PCB concentrations, as well as the extent of change in PCB concentrations over time.

Temporal trends in total PCB concentrations in surficial sediments from 2005 to 2007 are shown in Figure 21. In general, total PCB concentrations are higher in surface sediments sampled at the valley locations compared to ridge locations (Figure 21). This is consistent with the visual characterization data, which indicated that the valley locations tended to have somewhat higher silt content than the ridge locations (Section 3.1.5). Total PCB concentrations in surface sediments sampled at ridge locations in 2007 are among the lowest measured since 2005 (Figure 21). Total PCB concentrations in surface sediments sampled at valley locations are frequently lower in 2006 and 2007 compared to 2005 (Figure 21). Overall, there have been no substantive changes in annual total PCB concentrations in surface sediment at the OU3 Pilot Cap site since 2005, although concentrations appear to increase over time at ridge station OU4 and decrease over time at valley stations OU7, OU12, OU13, and OU14 (Figure 21). The range of total PCB concentrations has narrowed in 2007 compared to 2005-2006 (0.36 mg/kg to 9.7 mg/kg in 2005; 0.41 mg/kg to 17 mg/kg in 2006; and 0.24 mg/kg to 4 mg/kg in 2007), which may suggest a possible "smoothing out" as a result of horizontal and vertical mixing of sediment material by local current and wave action. Overall, the OU3 PCB data suggest that the cap placement is still effective in this area.

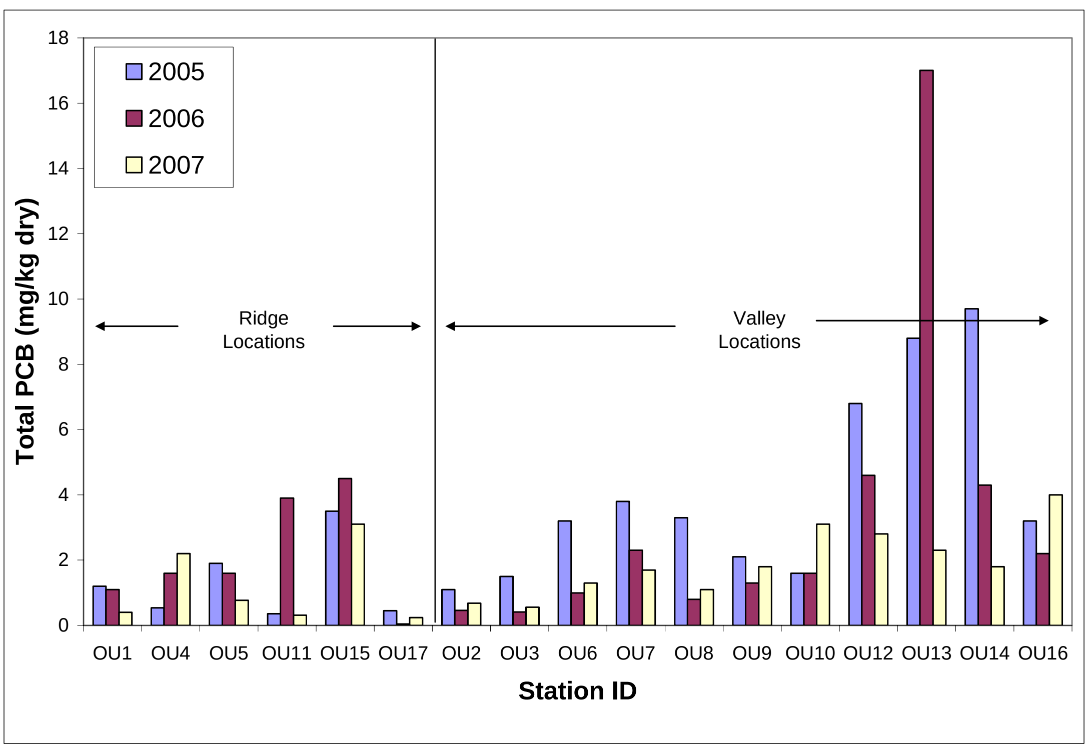

Figure 21. Total PCB in Surface Sediments Sampled at the OU3 Pilot Cap, 2005–2007.

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